THE HEATING AND VENTILATING MAGAZINE

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Cooling Buildings by a New Method of Construction

Approaching the problem of the cooling of buildings through a departure in the ordinary methods of construction is the way a Western architect has attempted to secure the desired results. His scheme has been recently patented and has already been tried out with success at Rialto, Cal., where an interior temperature has been obtained running as high as 32°

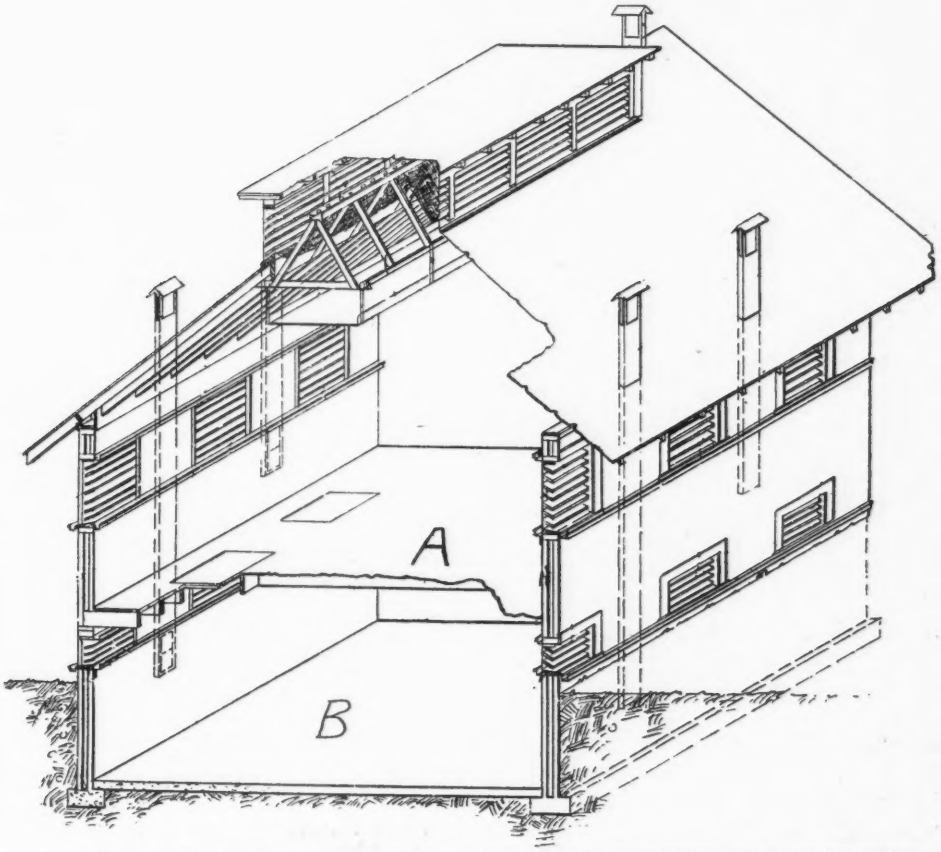


FIG. 1—TYPICAL CONSTRUCTION OF BUILDING TO SECURE COOLING EFFECTS

F. below that of the outside air when the outside thermometer has registered 110° F.

The method of construction is known as the Fellowes system and is the invention of Thomas Fellowes, of Los Angeles, Cal. It is described as a cooling system for packing houses, but has already been adapted for school houses and, it is claimed, may be used in practically any type of construction work.

Briefly, the system consists of a series of wooden strips fastened horizontally, but dipping downward to the outside, placed in the lower half of windows. On the inside, covering the opening and pressing against the strips, is a thick but loosely woven cloth. A line of water piping extends across each window directly above the strips. Through a series of perforations in the piping thin streams of water are allowed to run down over the cloth, saturating the fabric. The air from the outside, in passing between the strips and through the cloth into the building, is cooled by passing through the wet fabric. It then circulates through the building and is drawn out through partial vacuum exhaust vents extending through the roof. To further exclude the heat, the building is constructed of hollow tile blocks and double windows are used.

The roof is covered with insulating material, the outside layer being of tar with a special white coating.

The amount of water necessary for a one-story and basement building occupying a space 24 x 66 ft. has been found to be about 500 gals. daily. This is drawn from a tank designed for the purpose. The water flows by gravity through the pipes and is returned to the tank by means of a pump.

The accompanying illustrations show the scheme of construction in detail as applied in the case of a packing house for citrus and other fruits, especially lemons. In the arid regions and valleys of the interior of California the lack of moisture in the air wilts the lemons in storage on account of the liberation of the citric acid they contain and in humid localities the hygroscopic nature of the lemons absorbs the moisture, causing them to rot.

The air deflecting vanes, it will be noted, are substantially louver windows and the fabric used in the upper sills may be burlap, canvas or similar material.

The water as it escapes from the perforations in the pipes falls to a trough which extends longitudinally the length of the building walls. Thence it passes to the fabric strips.

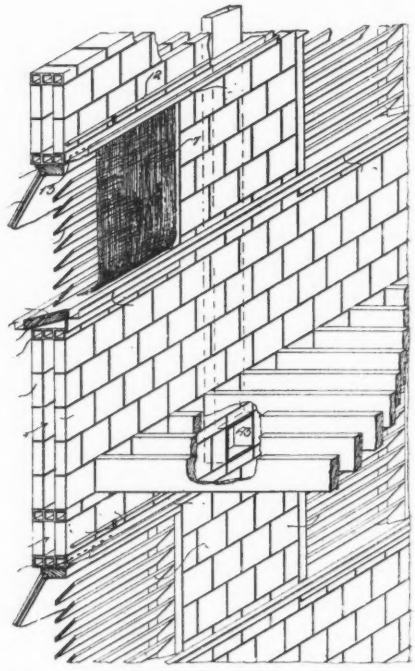


FIG.2—DETAIL OF INTERIOR OF BUILDING

The excess water which is not absorbed by the fabric or which is not vaporized by the inflowing currents of air, together with any other excess water, flows into a drain trough built on the outside of the walls directly below the windows.

In the typical construction shown, when the temperature of Compartment A (Fig. 1) has been reduced to the degree which the citrus fruit requires for its preservation the further lowering of the temperature is prevented by shutters secured to the tops of the window casing which, when shut, entirely exclude the air.

On the other hand, when it is desired to remove from Compartment A

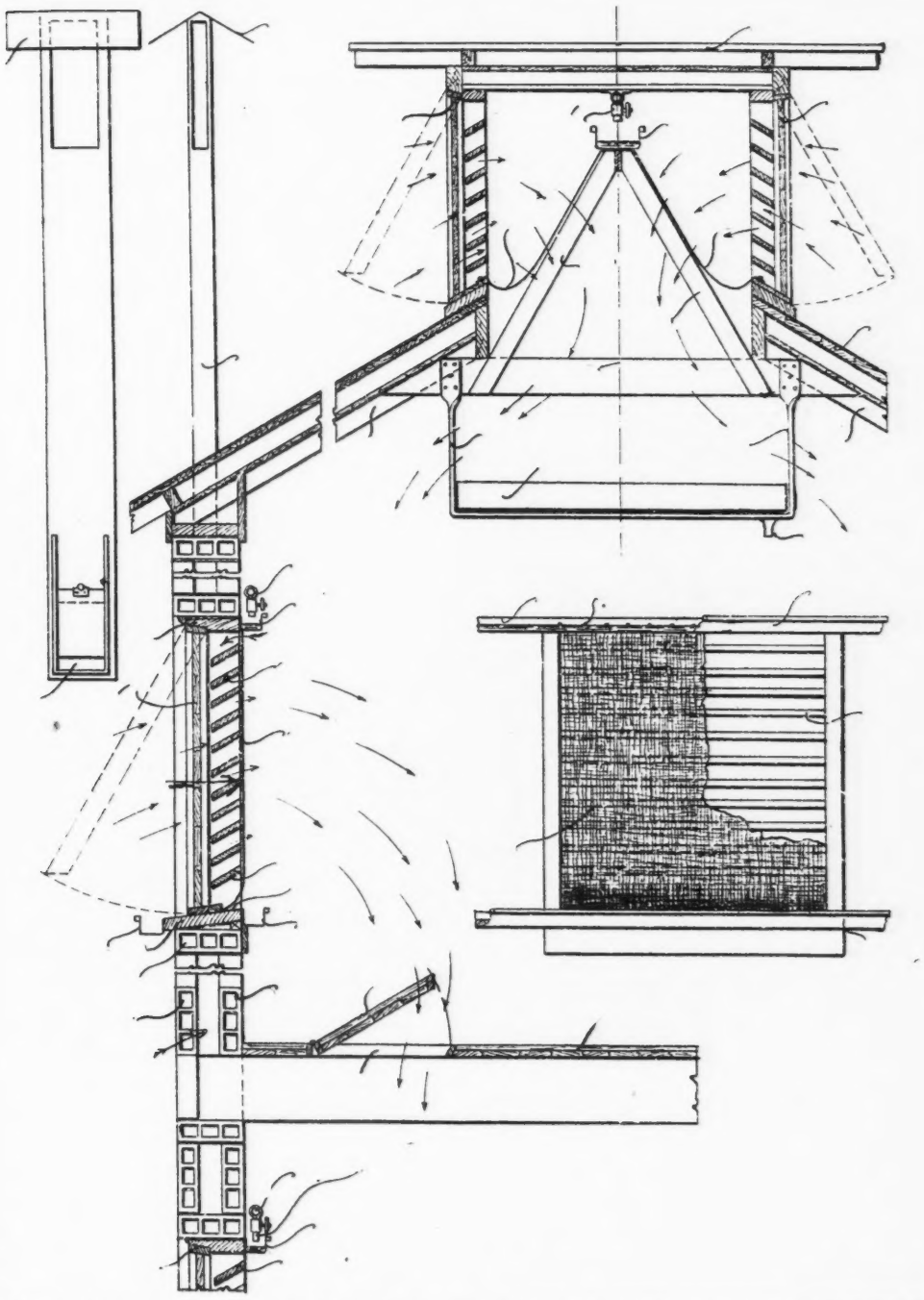


FIG. 3—ARRANGEMENT OF SCREENS, ETC., TO SECURE DESIRED HUMIDITY, SHOWING COURSE OF AIR

(Fig. 1) any vapid or stagnant air, vent pipes are provided in the hollow walls, the openings of which are controlled from the inside by means of slides or doors. The vitiated air thus passes out of the building without affecting the cooling process.

SEPARATE OPERATION NECESSARY TO OBTAIN NECESSARY HUMIDITY

The method of operation as thus described is designed only to reduce the temperature of the incoming air, as the amount of humidity thus supplied is not sufficient.

Fig. 3 shows the additional arrangements found necessary to procure the desired amount of humidity. It will be noted that the roof is capped by a dormer louver inside of which is a V-shaped frame fitted with strips of burlap, canvas or similar material. Directly above the frame is a water supply pipe provided with perforations similar to those in the other water pipes. The water flowing through the perforations, after saturating the strips, drops to a pan connected to a drain pipe. The dormer louvers are also equipped with shutters for the regulation of the humidity by cutting off the inflowing air.

When there is a lack of humidity in the main compartment, the operation of the system is as follows: The shutters of the dormer louvers are opened and the shutters of the wall louvers are closed. The air induced through the saturated burlap in the dormer louvers carries with it a certain amount of moisture which condenses and descends as a precipitate within the Compartment A (Fig. 1). When a sufficient amount of humidity has been obtained, the dormer louver shutters are closed and the shutters for the wall louvers are opened to effect the necessary cooling of the chamber. This humidity arrangement also serves to furnish the proper quantity of oxygen for the workman.

ARRANGEMENTS IN THE BASEMENT

The main compartment is separated from the basement compartment by a tight floor. The basement, generally used for storing, is therefore equipped with wall louvers, etc., similar to those of the main floor. To extract vitiated or stale air from the basement compartment separate vent flues are carried to the roof (Fig. 1) and by being independent of each other and placed at stated intervals in the basement walls of the basement, it is possible to create separate air currents in separate portions of the basement. The tops of the vent pipes, in all cases, are covered with hoods which have a coating to refract the sun's rays.

To supply humidity to the basement compartment the shutters of the dormer louver (Fig. 3) are opened, causing a precipitation of moisture within the main compartment. The descending currents of moisture-laden air are then caused to pass through trap doors (Fig. 3) built for this purpose in the floor of the main compartment. When a sufficient amount of humidified air, as indicated by a hygrometer, has descended into the basement, the trap doors are closed. Further precipitation of moisture in the main compartment is prevented by closing the dormer louver shutters.

The wall vents, it is claimed, leading from the main and basement compartments, aside from relieving the compartments of impure or stale air, may also be used to dry the air when the amount of humidity is greater than that required for the specified purposes.

In the development of the invention as described, Mr. Fellowes states that a special type of vacuum vent has been adopted which is not shown in the illustrations. In one installation of the system already made, the method of construction has been adapted for a meat market and, it is claimed, the system may easily be modified for creameries, hotels, churches, school houses, residences and factories.

A New System of Rating Warm Air Furnaces

One of the most ambitious schemes recently inaugurated in the heating trade is the standardization of the capacity ratings and rules for installing warm air furnaces. The plan has been carefully formulated by the Federal Furnace League and was announced as an accomplished fact by President Charles R. Prizer at the league's recent annual convention in Philadelphia.

The chief features of this plan, as stated by President Prizer, are the placing of correct, authoritative capacity ratings upon the warm air furnaces manufactured by the members

of the league and the furnishing to architects and heating contractors of correct, definite, standard rules for the installation of their furnaces. Additional features of the plan were outlined by Mr. Prizer as follows:

In the past it has been alleged that the capacity ratings assigned in "cubic feet" to their furnaces by many of the manufacturers showed too wide variations between minimum and maximum capacity and were indefinite and misleading. It has also been alleged that many furnace manufacturers failed to furnish correct or definite rules for installing their furnaces.

This new system of standardization in capacity ratings and rules for installation will remove all cause for these complaints so far as the members of the Federal Furnace League are concerned.

STANDARD CAPACITY RATINGS

The furnaces of the members of the league will be scientifically tested by a competent heating engineer employed for the purpose. These tests will be absolutely impartial and will all be made in a building which the league has erected for the sole and special purpose of conducting such tests. The tests will be made under uniform rules, uniform methods and uniform conditions.

The capacity ratings of the furnaces as determined by these tests will be certified by the consulting heating engineer who conducts the tests and by the secretary of the league, and will thus be official, certified ratings of the league. No member will be permitted to fix or assign his own ratings, but must take the ratings on his different furnaces as determined by the league tests.

Every furnace rated by the league will have its official rating published in the catalogue of the member who manufactures it. This official rating will also be affixed to the front of the furnace on a plate designed for that purpose or will be permanently cast thereon.

The official ratings will be expressed in "Federal Heat Units." Architects and heating contractors will be advised that only those furnaces whose ratings are published in Federal heat units and whose ratings are cast or affixed to the fronts of the furnaces have been officially tested and rated by the league.

All of the furnaces manufactured by the members of the league, except some of the cheaper and less durable constructions designed for competition "operation" purposes, will be officially rated; and it is the purpose of the league to have eliminated from the lines of its members as rapidly as trade conditions will permit all constructions not up to a high standard of durability and efficiency. It is apparent that the system of testing adopted by the league will in itself operate as a powerful influence to improve the constructions produced by its members.

THE FEDERAL SYSTEM OF HEATING AND VENTILATION

This is the formula or set of rules and directions for the installation of warm air furnaces prepared and adopted by the league as its standard authorized system. The Federal system will standardize and simplify furnace installation. It is founded upon the scientific facts of heating reinforced by actual experiments and by practical knowledge.

The members of the league assume full responsibility for all installations of their officially-rated furnaces when said installations are made in accordance with the rules of the Federal system and they warrant their furnaces to be amply capable of sustaining these official ratings in actual practice.

The league proposes, through a comprehensive and continuous scheme of advertising in the heating trade publications and architects' journals, and through the persistent use of its extensive mailing lists, to establish its plan of standardization so completely that there will be no excuse for the planning by an architect nor the installation by a heating contractor of a single imperfect or inadequate warm air heating plant anywhere in the United States.

THE FEDERAL HEAT UNIT

The Federal heat unit is the standard of measurement or "yardstick" adopted by the league and used under the Federal system in making the calculations to ascertain heating and ventilating requirements, sizes of pipes, sizes of warm air flues or risers, sizes of ventilating ducts, sizes of smoke flues, etc.

The Federal heat unit is a fixed number of British thermal units and is used instead of the latter term, in order to simplify the calculations by making them in relatively small figures.

The capacity ratings of the apparatus and the rules for installation have never been authoritatively standardized for any other than the warm air furnace method of heating and this standardization in the furnace business, which is now an accomplished fact, has been rendered possible only by a strong organization among the manufacturers of the apparatus.

The handbook containing the rules and directions constituting the Federal system of installation will be copyrighted and the league is now having executed a distinctive trademark design which will be imprinted upon the trade literature of its members, and will be cast upon the furnaces made by its members in connection with the official capacity rating.

Notes on the Theory and Present Practice of Humidifying

By W. H. Carrier

Speaking before the Engineers' Society of Western Pennsylvania at its recent June meeting on the subject of "Air Conditioning Apparatus," W. H. Carrier reviewed, in an interesting manner, the theory of humidifying, including a discussion of humidity control. The occasion was equally noteworthy for the prolonged discussion aroused by his remarks, which brought out phases of the subject having a direct bearing on present practice in this field of engineering.

The following, in part, are his remarks on the subject, together with the discussion, which appears in the society's proceedings for July:

The hygienic benefits of a uniform and proper degree of humidity, temperature and cleanliness combined with ventilation is now beginning to receive the serious consideration which its importance demands. The irritation caused by breathing excessively dust laden air, even though otherwise pure, is responsible for a large class of diseases of the respiratory organs. Moreover, the spores of contagious diseases are said to be conveyed entirely by attachment to dust particles floating in the air, making dusty air a double menace to health.

Aside from the hygienic aspect the process requirements in many manufactories make air conditioning highly advantageous, or even imperative. This is true in the manufacture of textiles, of photographic films, of all gelatine products, of various confections, in lithographing printing, in the malting of grain, in cold storage of many products, and even of highest importance in the smelting of iron ore. Moreover, it is safe to predict that it will be a short time only before an air conditioning installation will be required by law in every coal mine throughout the country as the only sure and practical means of preventing mine explosions due to dryness of the air in the mines in the winter months.

TYPES OF APPARATUS

Air purifiers are either of the dry air filter type, or of the moist washer type. The dry air filter has its legitimate field and is applicable wherever air is required to be cleaned without moistening. Properly designed it can

be made a fairly efficient means of removing solid impurities. As it is ordinarily employed, however, in the form of cheese cloth screens, or bags, of one thickness, it is very inefficient and hardly worth the trouble of installing. In most cases no adequate means of cleaning is provided and the screen becomes only a hindrance and a detriment to the ventilating system. To make this type effective, three elements are essential:

First, some mechanical means of continuous, or intermittent cleaning, which will not interfere with its operation.

Second, cloth, closely woven, or else several thickness of coarse mesh to obtain adequate cleaning, the ordinary cheese cloth in single thickness, will not answer.

Third, sufficient filtering area to avoid excessive resistance to the passage of air.

The second type of purifier, the air washer, has so many advantages over the dry filter for most purposes, that it has practically displaced the latter type. The usual form of washer depends for its action upon bringing the air into more or less intimate contact with water first in the form of a spray, and second in the form of a film on metal plates. The advantages of the air washer over the dry filter are: That it is compact; it is practically self-cleaning; it not only removes solid matter efficiently, but also extracts a large proportion of the soluble gases, such as sulphur dioxide, carbon dioxide, and offensive odors. That the latter may be removed most completely has been demonstrated by installations in the vicinity of rendering works and packing houses, where the air outside would be nauseating while in buildings ventilated with washed air the odor could not be detected. In such locations, of course, the water must be continuously changed, otherwise it would become saturated and ill smelling.

In the early attempts to wash air a coke screen was employed over which running water was allowed to trickle. This device proved very unsatisfactory because it either occupied too much space, or offered too great a resistance, and also it fouled with impurities very quickly, becoming ill smelling and a source of contamination. These difficulties soon led to its abandonment and to the adoption of the present types of air washers.

All mechanical washers have the following essential features:

First, a spray system for supplying the water, usually requiring some form of nozzle.

Second, a centrifugal pump for supplying the water under head.

Third, a washing chamber in which the air is brought in contact with the water spray.

Fourth, an eliminator for the removal of the water from the air.

Fifth, a settling tank for holding the supply of water which is recirculated.

Sixth, a strainer or filter for preventing the coarser dirt from entering the spray system.

Such types of air washers will all do a certain amount of humidifying depending on the degree of contact of the air with the water; none of them, however, as ordinarily used as washers, will give complete saturation. Likewise, they will not give the full cooling action theoretically available. Before discussing this feature more in detail it will be well to consider the underlying principles involved in air moistening.

THEORY OF HUMIDIFYING

It is a well known principle in physics that the vapor pressure or tension of a confined liquid increases with its temperature according to a definite mathematical law. It is also known that a volatile liquid will vaporize in air at any temperature at atmospheric pressure, and that the maximum density of this gaseous product will depend entirely on the temperature regardless of the presence of other gases or vapors. In passing from a liquid to a gaseous state a great amount of heat is absorbed. In general the heat of vaporization is greater the lower the temperature.

The phenomena of water vapor in the air, or humidity, clearly illustrates this. In Fig. 1 the upper curve shows

the density of saturated water vapor in grains per cubic foot, at different temperatures. It will be noticed that the density, or moisture holding capacity, increases at a far more rapid rate than the temperature; thus starting at 30° F. the first temperature rise of 10° gives an increase of 0.9 grains moisture per cubic foot, the second rise of 10° gives an increase of 1.27 grains, the third, 1.70, the fourth, 2.18, etc. The actual weight of water vapor per cubic foot is termed the absolute humidity and the saturation temperature, corresponding to this density, is called the dew point.

When saturated water vapor either alone or in admixture with air is raised in temperature without additional evaporation of water, it becomes superheated This degree of superheat determines what is known as the relative humidity of the air. The relative humidity is expressed as a ratio of actual vapor density to the density of saturated vapor at the same temperature; i. e., it is the ratio of what the air does hold to what it could hold at the same temperature.

When a superheated vapor is brought into contact with a liquid it immediately loses its superheat, partially through evaporation and partially by increase of vapor pressure.

In dry air, which is merely a mixture of air and superheated water vapor, the heat of vaporization is taken from the air, from the superheated vapor and from the water itself. When the saturation is completed the air and the water will be at the same temperature, which is obviously between the initial temperature and the dew point.

It may be demonstrated that water exposed to dry air and unaffected by any source of heat will remain at a constant temperature as it evaporates, which is considerably below the temperature of the air. This temperature is the same as that which the air will attain when it becomes saturated; this is known as the wet bulb temperature, observed by covering a thermometer bulb with a wet cloth. The difference between this wet bulb temperature and the actual temperature is called the wet bulb depression. This is a direct measure of the moisture absorbing capacity of the air.

For each degree depression of the wet bulb temperature a pound of air has capacity to absorb 1.4 grains of moisture. Knowing the number of grains of moisture air will absorb and the final temperature after absorption, it is possible to determine by mathematical calculation the number of grains the air contains at any temperature and wet bulb depression, also to determine the percentage of saturation.

The above theory applies in a very interesting way to the practical operation of air washers and humidifiers, and to humidity control. The cooling effect of all washers and humidifiers when the water is recirculated is due solely to evaporation and is always in exact proportion to the wet bulb depression of the air entering.

In a humidifier which has full saturating efficiency the air is cooled exactly to the wet bulb temperature, while in the ordinary washers the air is cooled only from 60% to 85% of the wet bulb depression, depending on the intimacy of contact between the water and the air. The spray water always remains at the wet bulb temperature, and the wet bulb temperature of the air remains constant regardless of the degree of saturation so long as no heat is added or subtracted. This effect is diagramatically shown in the chart, Fig. 1. The curved lines correspond to percentages of humidity, the nearly straight and parallel lines show wet bulb temperatures, and, therefore, indicate approximately change in moisture content under adiabatic conditions. In order to cool without the addition of any moisture the water used in the washer must be somewhat below the dew point of the incoming air. By carrying the temperature still lower and increasing the amount of water the washer may be used as a dehumidifier. There is one installation of these washers where air taken out of doors is delivered uniformly with a moisture content of 2.8 grains per cubic foot the year around, although the moisture content of entering air varies from ½ grain to 9

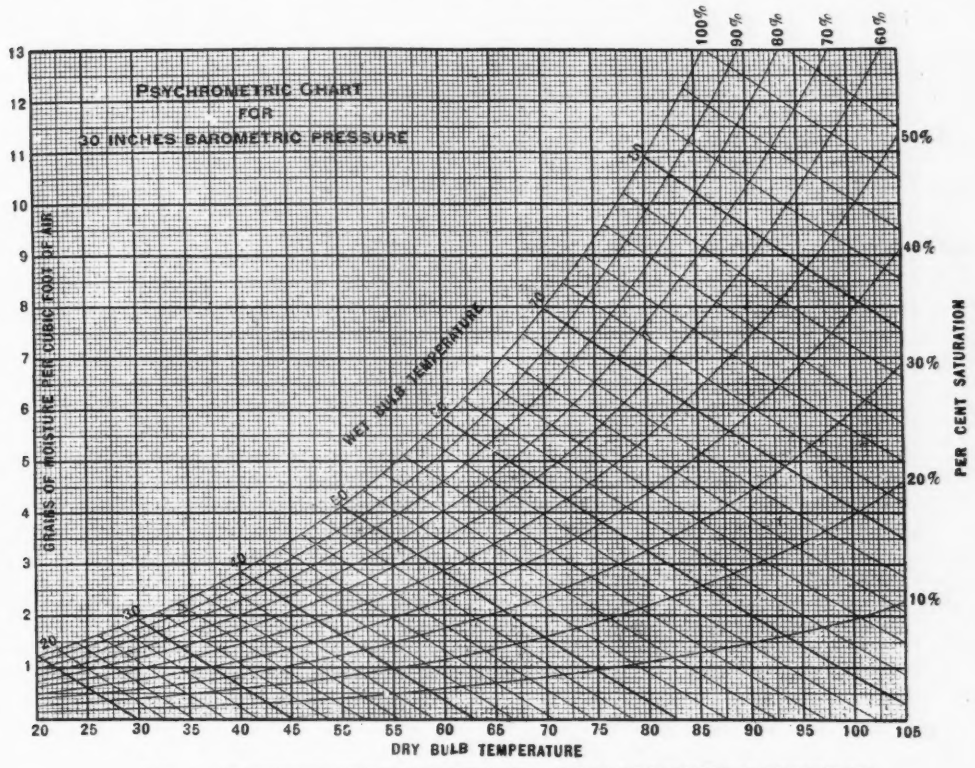


FIG. 1—PSYCHROMETRIC CHART FOR 30 INCH BAROMETRIC PRESSURE

grains per cubic foot. The effect of the washer in reducing humidity is similar to that of the jet condenser. The eliminator plates remove the condensed moisture effectively.

HUMIDITY CONTROL

Humidity may be controlled in three distinct ways:

First, by use of some hygroscopic substance as wool, hair or silk.

Second, by the use of a differential thermostat having two elements, one subjected to wet bulb temperature and the other to the dry bulb temperature.

Third, by controlling the absolute humidity, or dew point, with reference to the room temperature.

The first method is too unreliable to be of much value in accurate work. The second method of control can be made exceedingly accurate and is well adapted to regulating where there is a change in absolute humidity in the room to be conditioned. An instrument operating on this principle has, as its essential elements, two rods of hard rubber attached to a frame. These rods are arranged horizontally one above the other and the lower one is covered with a cloth which dips in a reservoir of water. This cloth serves as a wick and keeps the rod continually moist. These two expansible rods operate conjointly through a series of levers upon an air valve. In order that this instrument shall operate to maintain a constant percentage of humidity over a range of temperature it is essential that it shall produce no movement of the air valve so long as the humidity is constant. These two rods expand in opposite directions to each other and the dry element is provided with an adjustable leverage so that any desired ratio of action may be secured.

For example: In order to maintain 50% humidity the expansion caused by 8° rise in the wet bulb temperature must have the same effect as the expansion caused by 1° rise of temperature in the dry element.

Where the absolute humidity is but slightly affected by local conditions, the third form of regulating device is used. The simplest form of this con-

trol is that employed in public buildings for winter use. Here the air is saturated, delivered to the room where a higher fixed temperature is maintained than the fixed temperature at the air washer, and then, by varying either temperature and keeping the other constant, any desired percentage of humidity may be obtained.

For example: If we maintained a saturated temperature of 50° at the apparatus and 70° in the room we will have a relative humidity of 50%; if we lower the dew point at the apparatus to 40° and still hold the room temperature at 70° we will have 34% of humidity in the room as the result. On the other hand if we have a dew point at the apparatus of 61° and maintain one room at 70° another at 75° and a third at 80° we would have 75%, 64% and 55% of humidity in these rooms respectively.

An apparatus of this nature is used in the Central District & Printing Telegraph Company's building in Pittsburg. In this installation the air is tempered by direct contact with a heated water spray. The temperature of the spray is so controlled by means of a thermostat as to maintain a constant air temperature past the eliminator plates. The temperature of saturation is ordinarily maintained at 40°. The air is then drawn through the fan, passed through the tempering coils, and forced into the building. This method of fixed dew point regulation is only adaptable for winter use and is employed chiefly in public buildings.

In textile mills it is impossible to maintain a uniform temperature throughout the summer. Therefore, it becomes necessary to vary the temperature of the dew point as the room temperature varies. By referring to the chart it may be shown that the difference between the dew point and the room temperature is practically constant over a considerable range. This fact is taken advantage of in the control of humidity by means of a differential thermostat. This maintains a constant difference between the dew point and the temperature of the room and thereby regulates the humidity regardless of the room temperature.

Where several rooms are to be controlled from one central plant, the temperature of the saturated air at the apparatus is governed in cool weather only by means of the ordinary thermostat, thus preventing it from going below a certain specified temperature. Each individual room is controlled with reference to this humidifier temperature by means of a differential thermostat which operates upon the heaters and upon air dampers in the outlets to the room.

In this case an air differential thermostat is employed, one element being an air bulb placed at the apparatus in the current of saturated air. Each differential thermostat has a lever operated by two aneroid diaphragms in opposition. One of these is connected to the dew point element by a hollow wire tubing. The other diaphragm is connected to an air bulb of adjustable capacity placed in the room. The pressures in these diaphragms are opposed to each other by means of a lever so that a change of one degree of temperature in one element exactly counteracts one degree change in the other. This lever operates an air valve which controls the air supply dampers in the room by means of an air motor, and the radiation by means of diaphragm valves.

This system of humidity and temperature control has been very successfully applied to a large number of textile mills. The advantage of this system is that it gives uniform humidity throughout the year and it permits the lowering of temperature in the mills several degrees in the summer time.

Another field in which air conditioning must sooner or later be generally adopted is coal mining. The numerous and disastrous explosions that have occurred during the past winter are sufficient evidence that further precautions should be taken. To say that three-fourths of these could have been prevented by proper conditioning of the air supply in the mine is no exaggeration. This, as statistics will confirm, would have saved hun-

dreds of lives and millions of dollars. A large part of these mine explosions were caused, or augmented by dust, which accumulated owing to the dryness of the mines.

The temperature in the mine remains uniformly between 55° and 60° winter and summer. It is quite noticeable that there are rarely any explosions during the summer months when the absolute humidity is high. Whenever the dew point of the external air is above the temperature of the mine, moisture is deposited on the walls of the mine. However, when the outside dew point is below 55° the air remains unsaturated and the mine becomes dusty. In extremely cold weather the moisture content of the air is very low, and the air when heated in the mine to approximately 55° has an exceedingly low percent of humidity. This causes the walls to dry so rapidly that it is impossible to keep them moist by any of the usual means of spraying. By use of proper air conditioning apparatus in connection with the air supply, summer conditions may be reproduced in the mine without any appearance of fog, or other objectionable features, and the mines may thus be kept in a perfectly safe condition where it is now an impossibility.

DISCUSSION

MR. A. R. RAYMER: How is the humidity controlled during the winter months and in summer months?

MR. CARRIER: The air is heated and saturated by means of a water spray of variable temperature. This temperature is automatically controlled by means of a thermostat subjected to the saturated air temperature, so that the latter is maintained constant, say at 40°. By controlling the temperature of saturation a fixed number of grains of moisture are held in the air. When this saturated air is raised to the room temperature, the proper relative humidity will be secured, depending upon the difference between the temperature of saturation and the room temperature. When the outside wet bulb temperature is above the saturation temperature desired, perfect control is impossible without refrigeration.

In summer time the humidity cannot be kept as low as desired without refrigeration. In the plant I spoke of where they had a saturation temperature of 40° all the year around, this was obtained by cooling the water below 40°. This is the only way that humidity can be reduced except by use of some moisture absorbing chemical such as calcium chloride. But the use of this in the ordinary plant is more undesirable than the refrigeration. It imparts an odor to the air which is very objectionable. In the plant mentioned about all that can be accomplished is to prevent an increase of humidity. On exceptionally humid days this is accomplished by cutting off the sprays and using cold water through the flooding sprays on the baffle plates: the water being below the dew point of the air, will precipitate moisture from the air rather than cause it to take up more.

Now I will not say that the relative humidity of the air will not be greater after it leaves the washer than before, but it will have fewer grains of moisture in it per cubic foot, and by bringing it back to its original temperature there will be a slightly lower relative humidity. A distinction must be made between relative humidity,. which depends both on temperature and on moisture content, and absolute humidity, which depends on moisture content alone.

MR. A. G. LUDGATE: I would like to ask if the quality of the air, in passing through these washers, is in any way changed, and to what extent, especially as regards the chemical composition of the air proper and the contained gases, and particularly as to the amount of free oxygen in the air.

MR. CARRIER: There are a large number of installations in the schools at Cincinnati where they have about every washer on the market, at least every one mentioned to-night. There they have made a bacteria test which is very interesting. By obtaining cultures of air samples they have found that the colonies of bacteria after the air has been washed have been reduced to about one-third what they were originally.

MR. A. R. RAYMER: In regard to humidity, Mr. Carrier has spoken very fully and I do not know that I can add much, except to give you some examples of what we have accomplished. During 1902, which was the first year after the plant in the terminal station of the Pittsburgh and Lake Erie Railroad was in service, we took humidity tests three times daily throughout the entire year. During the month of December the average absolute amount of moisture in each cubic foot of air was 1.4 grains. The average relative humidity outside, from the government reports, was 76%. During the same month the relative humidity was only 39% in the office building while the outside relative humidity was 76%. In other words the air was much drier after it had been washed and tempered, relatively, than it was before it was conditioned.

During the month of August the amount of moisture in each cubic foot of air was 6.3 grains, with a relative humidity of 64%, and in the office building we maintained a relative humidity of 70%.

About 60,000 cu. ft. of air are handled each minute by this plant. To wash this air requires about 250 gals. of water per minute at the sprays. To force this air into the rooms, three motors, two 10 H. P. each and one 7½ H. P., are used. With that amount of power handling the air into the rooms, only 10 H. P. is used in removing it. In other words the air in the rooms is under a slight pressure, the object being to have all air leaks from the inside out, rather than from the outside in, so as not to allow dust and dirt to be drawn into the room.

We made some tests to determine the amount of dust removed from the air. The quality of the dust consisted of powdered coke, ordinary soil or dirt, pulverized horse manure, and such materials. About 90% of that is removed by the washing plant we have, 10% apparently leaks through. We have the greatest trouble in removing dirt when the weather conditions are foggy combined with smoke. For some reasons which we have not been able to determine, that kind of material apparently goes through the washer. It may be on account of the smoke being more or less oily.

During the summer months the water is used once and wasted; in the winter it is recirculated and when it becomes dirty is replaced. From the amount of mud removed from the tanks we have made an attempt to determine the quantity of dirt taken out of the air. The results show something like 3500 lbs. removed from the air for the whole building per year. During the summer months instead of using river water, well water which has a temperature of between 50° and 55° is used. This water is used in the sprays and has a decided cooling effect on the air, the result being that we have been able to keep the temperature in the office building at a maximum of about 12° cooler than the outside temperature, or an average of about 5° or 6°. 12° is too much difference, as it causes chills, particularly after one has become heated; a difference of 10° is about the limit for comfort. The system has been generally conceded to be successful. It makes conditions in the offices much more pleasant than they could be by ventilating through the windows on account of the dust that is in that neighborhood.

MR. V. R. COVELL: When the Allegheny County Court House was erected 25 years ago it was ventilated by means of fans in the basement. The basement was used as a plenum chamber from which ducts led to the various rooms. A washing device consisting of perforated pipes was also installed, but as there were no eliminators the entrained water was carried through the building and the washing was soon discontinued. The air, which was drawn from the top of the tower, was heavily laden with dirt and in a number of offices the fresh air registers were always kept closed to avoid the dirt nuisance.

During the year 1907 a new ventilating and air washing system was installed under the supervision of Prof. S. H. Woodbridge. The air supply is tempered and washed by the Acme system and is then carried to

the various rooms through ducts so that it is not again contaminated by the machinery and by the various kinds of work performed in the basement. The electrically driven centrifugal pumps, originally part of the air washer system, have been replaced by duplex, steam, tank pumps. These air washers are giving very satisfactory results at the present time.

The new County Morgue, erected about 5 years ago, was also provided with an air washer of the same type. The sheet metal work was of copper held in place by galvanized iron angles and after a comparatively short service these angles were found almost rusted away. This was explained as the result of electrolysis and when the repairs were made galvanized iron was used throughout. Sufficient time has not elapsed to compare the durability.

MR. F. C. SCHATZ: There is an installation in a church in our city (Pittsburg) which may be of interest. It contains a fresh air supply and extraction system, together with a means of cooling the fresh air entering the building. The circumstances leading up to the installation are briefly as follows: The minister at the time was anxious to be able to attract an audience in hot weather and have them feel comfortable while in the building, and the question at once arose as to whether the cooling should be done by a refrigeration plant or by means of ice supplied in cakes from the outside. The latter method was adopted. Fresh air is taken in at the roof by means of a fan placed in the basement, and the air carried up under the pews and in the aisles. The air was first washed and cooled. The foul air was taken out at the ceiling by means of a duct system which maintained a circulation of air practically throughout the entire church. Some trouble was encountered in regulating the quantity of air taken in and discharged, but this worked itself out in time. This system was followed up for perhaps two summers, when the cooling feature was abandoned. It was found that ice bills were enormous, although not as expensive as to have installed a refrigeration plant. However, both systems operating at once, that is fresh air and exhaust, were finally accepted as being satisfactory and the use of ice discontinued. Furthermore, the system after having been in use for this length of time, showed signs of corrosion, which would have meant considerable expense to overhaul.

MR. JOHN ALLISON: I would like to ask if in the P. & L. E. Terminal Building the same system is used in the waiting room that is used in the offices? I have noticed a different odor frequently in the waiting room, but that may not be due altogether to ventilation.

MR. A. R. RAYMER: As the installation that was put in there was practically the first of its kind, we found that we had some errors to correct, which I will be free to speak about for your information. Ordinarily in ventilating an office the foul air is voided from an opening near the floor. When the heating plant and the ventilating plant were installed in our building, that method was followed. We found after one or two years' use that the results were not good. It became necessary to change the ordinary practice and design something to meet the requirements. In this system the ventilating air is cooler than the maintained temperature in the rooms, consequently the best air is at the floor. The air as it remains in the room becomes warmer and goes to the ceiling, consequently the foulest air is at the ceiling. So we made a very simple inference that the ceiling was the place to void the foul air. In the mornings there was an odor of staleness. The fresh air was by-passing; as it entered the room it fell to the floor and was drawn out, and from an elevation lower than a man's head, the air became more or less stagnant during the night. After we changed the location of the openings for withdrawing the foul air, this was entirely overcome.

Heating, Ventilating and Humidifying Features of a City Residence

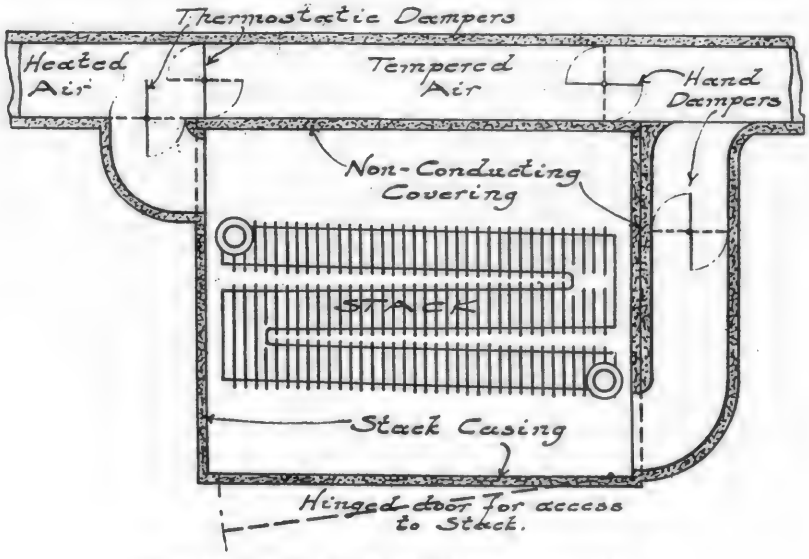
HOT WATER HEATING SYSTEM IN HOME OF EDWARD S. HARKNESS, NEW YORK

Some idea of the heating comforts that may be had in a city residence are to be seen in the accompanying illustrations which are, in many respects, typical of the best present-day practice for this class of work. The building is of the usual city type, with five stories and basement. The general heating scheme includes arrangements for supplying the principal rooms on each floor with fresh warm air which is conditioned by being passed through air filters, tempering coils, a second set of air filters and finally over air moisteners before being sent through the ducts. An exhaust ventilating system extracts air from the principal rooms and bath rooms and from the service portion of the house, the vent flues extending to the roof and connecting there with disk fans. Other rooms which are not supplied with fresh air are heated by direct radiators.

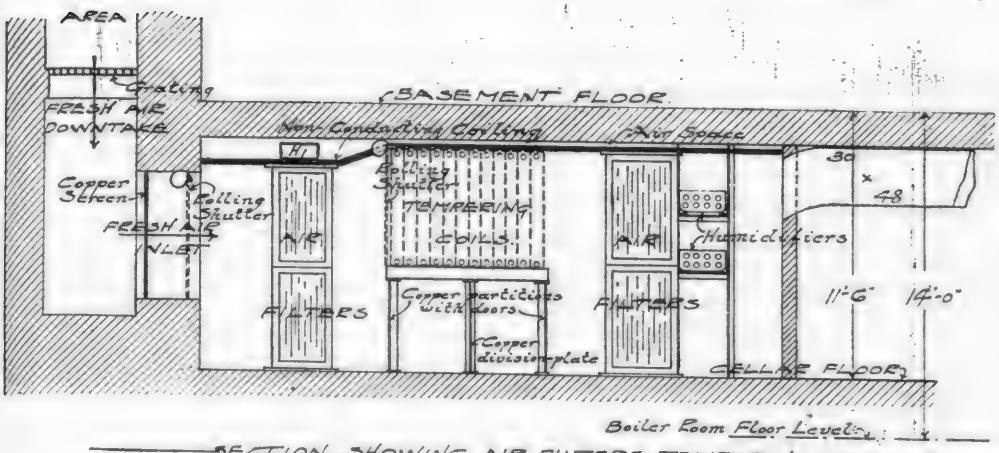
RESIDENCE OF EDWARD S. HARKNESS, NEW YORK

The layout of the heating apparatus in the basement is shown in the accompanying illustrations. The tempering coil contains 1550 sq. ft. of heating surface, made up of 3-in. pipe with return bends, 12 rows high and 10 rows deep. The three outside rows of the coil are under hand control, while the inside rows are controlled automatically.

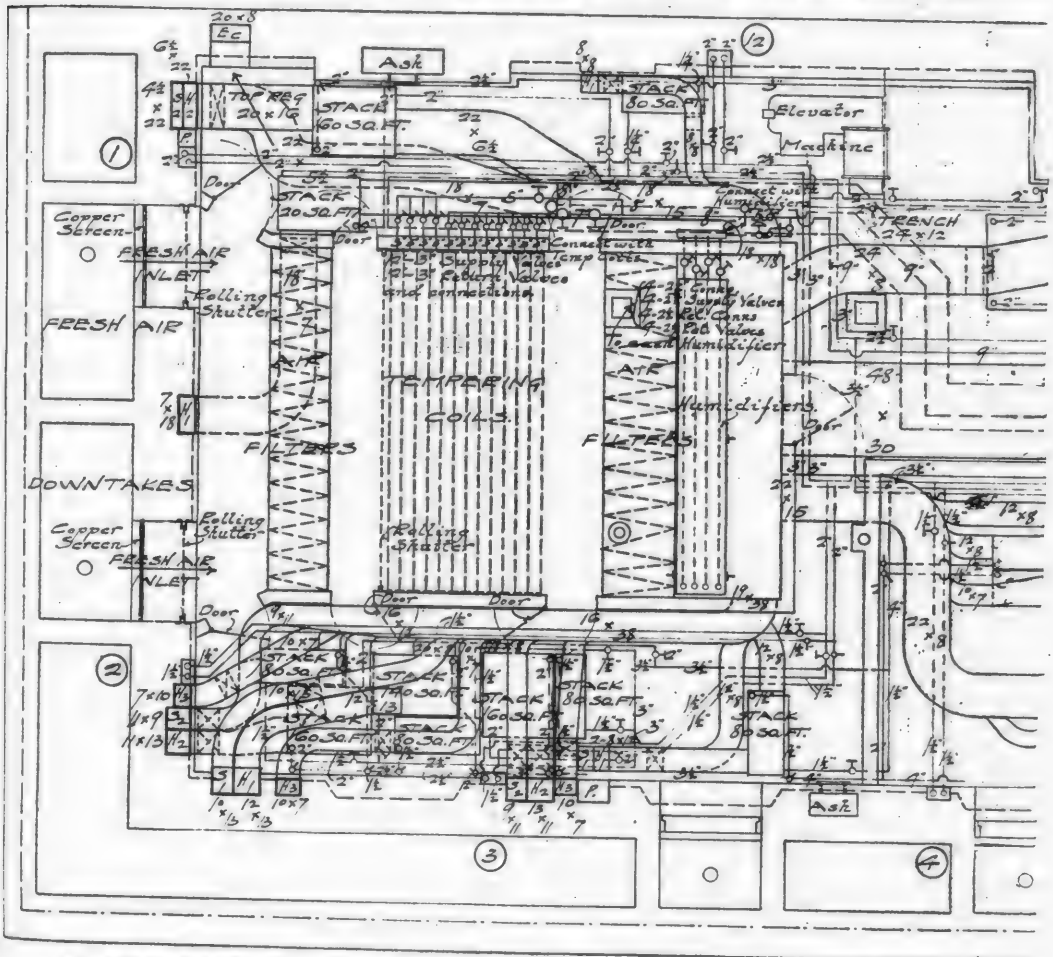
Air filters are placed on each side of the coils so that the air is filtered before and after passing through the



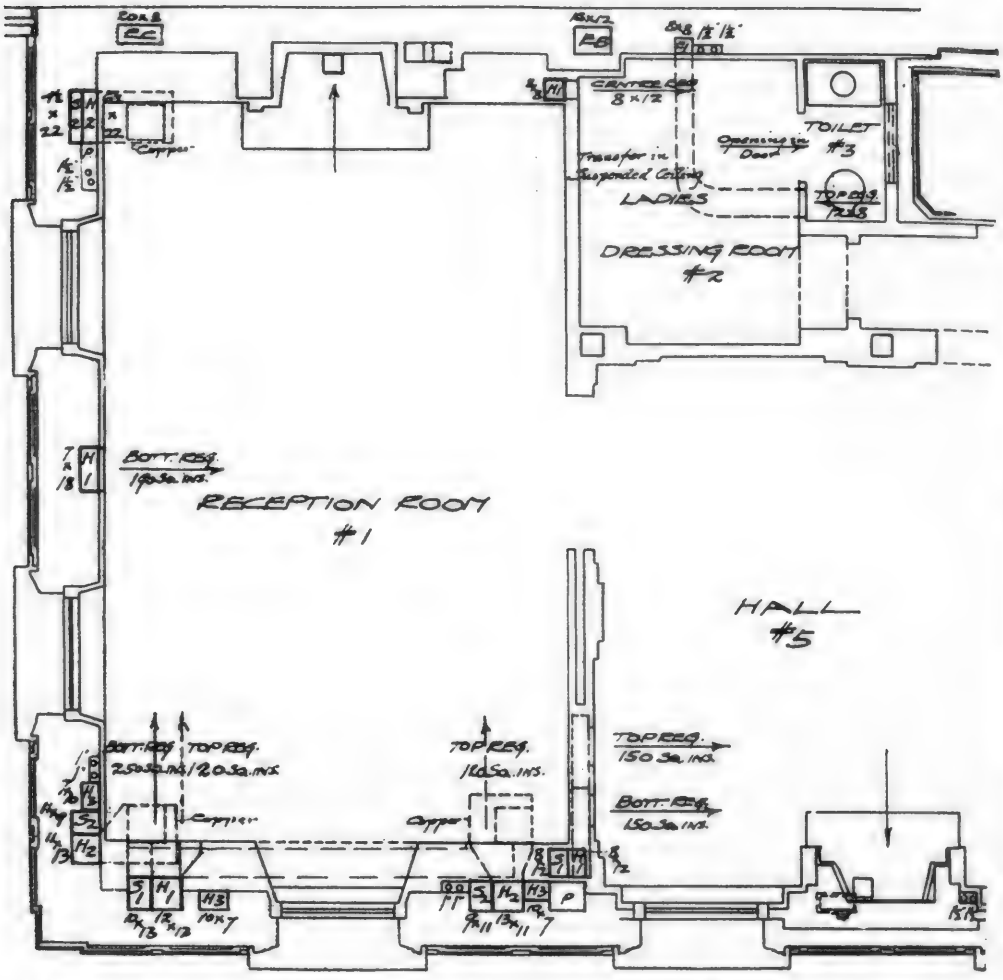
DETAIL OF ONE OF THE HEATING STACKS



SECTION SHOWING AIR FILTERS, TEMPERING COILS, ETC.



PART PLAN OF BASEMENT SHOWING AIR FILTERS, TEMPERING COILS AND HUMIDIFIERS
RESIDENCE OF EDWARD S. HARKNESS

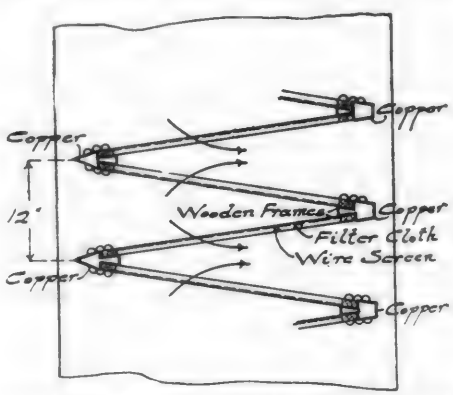


PART PLAN OF FIRST FLOOR, SHOWING ARRANGEMENT OF TOP AND BOTTOM FRESH AIR REGISTERS

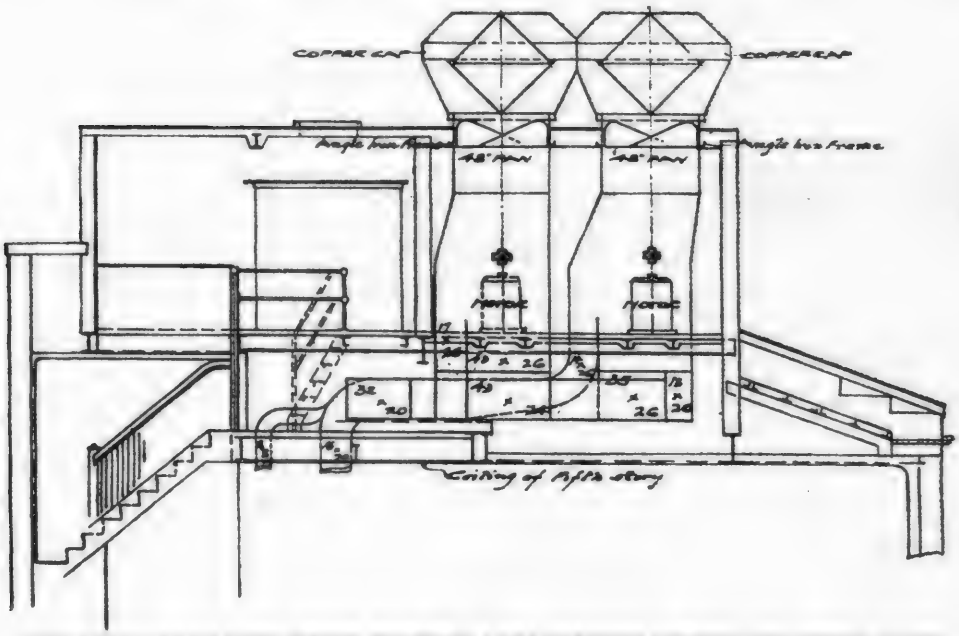
coils. The air filters are of the cheese cloth type, the cheese cloth being laid on copper wire netting and set in frames, wooden frames. They have a total filter area of 800 sq. ft.

The humidifiers are an interesting feature of the arrangement. Each humidifier consists of an evaporating pan, located in the fresh air chamber. Each pan has an evaporating coil of brass, containing not less than 100 lin. feet of 3-in. pipe, divided in sections for hand control. The coils are entirely submerged in the water. Each pan is provided with an automatic water feeder with float valve, also drain connections, etc.

Another feature of interest is the arrangement for regulating the tem-

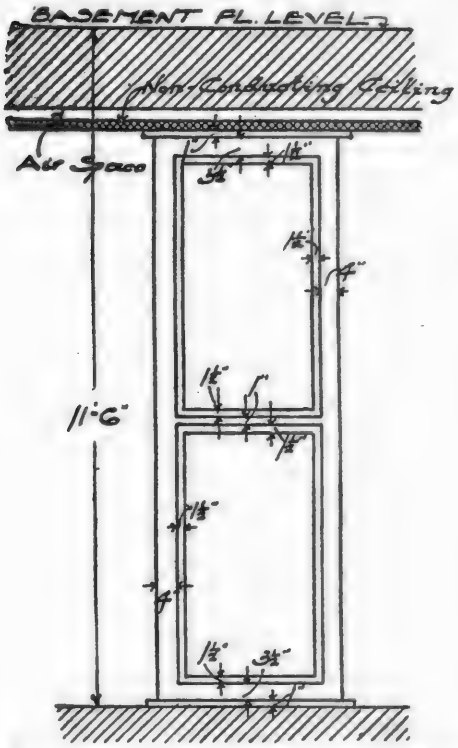


DETAIL PLAN OF ONE OF THE AIR FILTERS



SECTION THROUGH PENT HOUSE, SHOWING ARRANGEMENT OF EXHAUST VENTILATING APPARATUS

perature and flow of the air in the rooms. Two separate fresh air supply flues are connected to each of the principal rooms, one having an outlet at the bottom of the room and the other at the top. These are under thermostatic control. When the thermostat closes the warm air register at the bottom of the room it opens the tempered air register at the ceiling. In this way the cool drafts sometimes noticed where the warm and tempered air passes through a single flue are avoided.



ELEVATION OF ONE OF THE AIR FILTERS

In connection with the exhaust ventilating system, which is operated by two 48-in. disc fans on the roof, a system of ducts connects the fire place flues and the exhaust flues from the kitchen with the exhaust fans.

The apparatus was designed by the late Alfred R. Wolff, the work being in charge of T. S. Tenney, of Nygren, Tenney & Ohmes, his successors. The architects are Hale & Rogers, New York.

If there is any one thing that we know less about than another it is the absolute value of chimney draft. Almost every authority takes the temperature of the chimney as being uniform from the bottom to top, but we know that it is not. Yet computations are made on that basis.—E. A. MAY *before the Heating Engineers' Society.*

The Insulation of Pipe Lines

Editor's Note:—This subject, together with methods of charging for heating, is one of the most vital problems at present engaging the attention of the district heating engineer. The discussion of the subject, at the recent Toledo convention of the National District Heating Association, is contained in the following symposium.

I—INSULATION

By W. E. Richards, Toledo Railways & Light Co., Toledo, O.

Fundamentally, we find that confined air (dead air) is our most practial insulating element. Also to divide the air into small particles is the most efficient form. Now to accomplish this has occupied the time and ingenuity of many engineers.

District heating was first started about 40 years ago and its apparent failure—in fact dormant condition was due to lack of proper knowledge and methods of conserving heat—meaning insulation.

To show to what extent the improvement of insulating has progressed, we need only to state that manufacturers of insulating materials will guarantee to protect steam mains to that degree that they can run steam at 50 lbs. pressure ½ mile with not over 2° drop in temperature.

To rob steam of 20° of heat when considering exhaust steam at low pressure is not a difficult problem—in fact not to do so was until recent years the main point, for if that took place you had condensed steam (water) and at the same time excessive loss if not failure.

In hot water heating, we have a reverse action—in a way—for while steam, the gaseous condition of water is very low in specific heat, water in the liquid condition is very high, in fact the highest of our common elements—eight times that of iron.

In laying hot water mains with a forced circulation, they are laid just under the surface, not to grade and hence take the contour of the surface, and hence are subject to some moisture and occasional floods due to lack of proper drainage, etc. This is more because the well known wood box construction is used. There are several causes for this—necessity for low installation cost—high specific heat eliminating excessive or disastrous losses—reconstruction or extension additions, reduction in life of pipe with water as compared to steam—in residential districts the increase of houses and changing of this phase by new buildings and changes resulting.

From the writer's standpoint an insulation subject to knocks or jars, or excessive moisture calls for wool felt. It can be met so far as moisture is concerned, and successfully, by waterproofing, but this at added cost and for hot water mains is a debatable point.

Magnesia and asbestos seem to hold the place on high pressure steam and, of course, maintain a prominent position in low pressure work.

A concrete construction complete with wool felt lining for hot water main with feed and return main of 4-in. pipe will cost approximately complete as a main, with expansion joints, anchors, $6 per foot.

A triple wood box, with shavings, main same as above, will cost 35% of same or about $2 per foot. Now, without decrying the concrete construction, which is good and for steam is probably one of the best, to affect the 65% difference and to be sure of reasons to adopt either is worth knowing. Should we make our conduit to outlast the pipe and how much longer will we prolong the life of the pipe with the permanent duct over the wooden box?

In taking up the heating system in buildings, the question comes up about insulation and we have this matter presented to us from two points of view. One is that of the heating company and the other is that of the consumer, or owner.

As a rule, most heating jobs will have a certain amount of exposed piping, which will vary from 20% to

30%, or even higher, that is, the heating surface of the mains will equal the amount approximating 20% of the installed radiation.

These mains uncovered dissipate the heat from the element in the mains, either hot water or steam, and are of such importance from this point of view that the manufacturers of heating equipments specify that their apparatus is booked for so many feet of radiation, including all uncovered mains.

On the basis of contracts, from the heating company's standpoint, where the flat rate is used, which is practically universal for hot water district work and also to some extent on steam heating, they insist on recognizing these exposed mains unless the same are covered.

When the contract is on the meter basis the consumer, from a matter of economy, is immediately transferred to the former position and he proceeds to have these mains covered so that indirectly the results are the same and insulation becomes our friend to the extent of giving us economic relief from excessive losses.

DISCUSSION

MR. POWELL: Too many people lay their mains just below the surface. We lay our mains about 4½ feet below the surface. The author speaks of triple boxing, with three boards. We use four instead of three and our loss is comparatively nothing. Our water goes out at about 200°, with a loss of 28° in 11 miles, double pipes. The pipe mains ought to be laid below the frost line always.

PRESIDENT ROGERS: We find that in some ways we are handicapped on our mains for this reason. In this city (Toledo) we have broad sidewalk beds. We prefer to lay our mains in the sidewalk bed for two reasons. The first is that the expense is less; the next, the maintenance cost in the matter of repairs is greatly reduced for the reason that we do not have any repaving to do; at most, it is a matter of a load of dirt or some sod. Also, we are working with the city to prevent any breaking of the paving, unless absolutely necessary. On our streets, having a soft tile sub-drain just about 3 feet below the ground, we find it very detrimental to us if we put our mains below that, because if we do, we will take the water out of that drain instead of delivering it into it.

MR. POWELL: Our mains are laid in alleys principally. The drop in pressure does not come from condensation; it comes from friction. Then again, the specific heat has nothing to do with the loss of sensible pressure or even drop in temperature. The drop in temperature in hot water circulation does not depend so much upon insulation as it does upon how good the radiating effect is if the radiators are on. It is difficult to circulate the mains with all the radiating surface shut off, which would give the drop in the flow mains.

PRESIDENT ROGERS: In connection with insulation there are two matters, especially with hot water mains, that will govern your drop. Part of it is caused by the mains. That is your circulation velocity. We have some cases here where the drainage is unavoidably bad and which would mean going into a question of sewerage probably, although in a small territory, to correct that; and it would also mean going into the streets in a way that the city should take care of. You will find that in the winter time people are generally agreed that you can trace the lines of a hot water system in the streets by the melting snow. The results of our investigation show that that is not all due to the radiation so much as it is to seepage from the ground coming into the main from below and then vaporizing.

II—A STUDY OF UNDERGROUND INSULATION

BY C. H. STATEN, CLEVELAND, O.

It has been an accepted fact for some years past among engineers and, in fact, all who have anything to do with either the expenses for or operation of steam plants, that the central station is without doubt the most eco-

nomical. It will be, I think, just as readily admitted that no matter how fine the equipment placed in such a plant may be, the true measure of efficiency from the standpoint of actual net returns—dollars and cents—(for to such a basis everything in modern times is referable) depends on the type of insulation used for the protection of the pipes carrying this gaseous gold to the mint.

In considering this subject it will be said by all without question that the main losses to be encountered in a central heating plant are from the pipes run underground rather than any other section of the system, and I might say that in the case of from 50% to 60% of such plants which at the present time are not representing a profitable investment, the losses incurred by improperly protecting these arteries, the underground lines, are entirely responsible for their discouraging condition. This has several sides which will be taken up in their proper sequence.

EARLY TYPES OF INSULATION

In the early underground work many and various were the forms used in an attempt for the protection of these underground pipes, chief among which is the crude wooden box in which the lines were placed, with and without insulation, this latter for the most part consisting of sawdust, burlap, newspapers, or, in fact, any material available, which in the individual mind possessed any degree of suitability. Such pipes would have shown better results both from the standpoint of efficiency and durability had no attempt at insulation been made, and the pipes merely enclosed in the box.

Then several efforts were made toward the protection of the box-waterproof paper, waterproofing compound, creosoted lumber, etc. To all, however, judging from the experience gained in the past decade, the futility of such attempts was apparent. Moisture from without, heat from within, and the natural disintegrating effect of the surrounding conditions, enhanced by these ever present agencies, brought about the next step toward perfection—the brick trench with the creosoted plank top. This gain was another step toward protection, and as in the case of its predecessor, this type was used both with and without insulation, though here the types of nonconductors sanctioned by previous use were in some measure replaced by mineral wool. The development of this brick trench did not prevent many of the distributors of heat in those days from still continuing the use and installation of the wooden box construction, for though the brick trench beyond question was the more durable of the two, still from the standpoint of either insulation or protection nothing was gained to offset the higher cost of the sewer construction.

Aside from the fact that the wooden cover was a source of continual trouble, it was found that the trench itself acted more as a drain for the immediate vicinity than as a shield against just such conditions. This also had the effect of nullifying these attempts at insulation, as the materials employed were such as to draw the water at the bottom of the trench by capillary attraction around the pipe, thereby changing their entire status in the case. In this type, therefore, as formerly, it would have been better to eliminate the attempts at insulation for the same reason. Furthermore, these trenches as then constructed, open as they were at both ends, formed ideal breeding places and favorite promenades for vermin of all kinds.

The next form to be evolved was the brick trench, with a brick arch in place of the creosoting plank. While again the cost was increased, it was still without any appreciable advantage, from all practical standpoints. The materials used in this construction were not moisture proof.

The objections applicable to these forms are just as applicable to the more modern concrete trench construction, and this has, like its predecessors, gone down to the days of antiquity in the minds of modern engineers.

The next steps bring us to the more

modern forms of protection and insulation for underground lines, such as the expensive concrete tunnel, the better forms of built-up wood coverings and tile conduits.

CONCRETE TUNNELS

In the case of the first mentioned, the concrete tunnel, a great deal may be said pro and con. Of the arguments in its favor, the individual conditions must govern its size and methods of construction, and these in turn in a sense form an index to its degree of efficiency from the economical standpoint. It may be granted that properly constructed and thoroughly waterproof, such a tunnel forms an efficient protection for the enclosed pipes; still holding to our original subject, we must face the problem of insulation.

While these developments have taken place, all tending toward complete protection, the manufacturers of insulating materials have kept pace with the times and made forms of covering to suit every condition, whether underground or overhead, whether high or low pressure, whether outdoors or indoors. Underground work, however, has many peculiar phases, and it is essential that in tunnels the best class of covering known be used.

While there are several types on the market, varying in efficiency from 70% to 85%, the selection of sectional covering must receive careful attention in order to secure such types as will represent the highest possible efficiencies, for the greatest length of time. It must be further borne in mind that tunnels for the most part are in use only for a certain part of the year and during their period of disuse, no matter what their construction, gather moisture. This being the case, it is further seen that such efficiencies must of necessity be entirely contingent upon a further course of protection given the covering itself, Flanged pipe being generally used in tunnel construction, it is essential that these radiating surfaces represented by the flanges, which are commonly left uncovered, be taken into consideration, and for this reason the covering manufacturers provide removable flange covers which permit ready access to the flanges in case of need, and may be re-applied without deterioration. While it is essential that every possible square inch of heated metal be properly covered in tunnel construction, it is necessary that a certain amount of pipe surface remain bare in order to provide at the rolls a bearing and allowance for the ever present factors of contraction and expansion.

While it is possible to obtain efficiencies up to 85% by the use of sectional coverings in tunnels, these, as a rule, must be purchased with what money is left after the tunnel has been built and the pipe installed. For that reason, in the majority of the existing tunnel installations, such efficiency, which may readily be considered the maximum of possibility in such construction, is not often realized. While such a construction affords ready access at all times to the piping, and a passageway for the workmen between buildings, it also permits a free interior circulation of air, which, to say the least, is not beneficial.

INSULATION MUST BE PROTECTED FROM MOISTURE

The increasing use of low pressure and exhaust steam in central plant work has made essential the use of still better insulating mediums than any sectional form of covering at a lower initial cost of installation, and this demand brings with it the necessity of improvement in another phase of the underground construction which is in all such work no less important than the main feature of insulation itself—the protection of such insulation from moisture. These conditions demand a form of protection from the insulating material which will insure permanency of the installation, and an insulating material within this protective covering no less staple. With such a combination an efficiency should be obtainable of from 90% to 95%.

This, then, makes it necessary to regard both protective covering and insulating mediums as one unit, not as two separate considerations.

Ventilation in Its Relation to Health

By William G. Snow

(*Concluded from last issue*)

It has been pointed out among the causes of atmospheric vitiation and discomfort that high temperature and humidity have much to do with the oppressiveness of the atmosphere in occupied spaces.

As to desirable and practicable relative humidities in rooms occupied in winter by persons in health, taking into consideration the cost of maintaining a high relative humidity in cold weather and the trouble from condensation on windows, I am inclined to favor a range from 40% to 50% according to the weather, rather than a higher relative humidity.

HUMIDITY IN MANUFACTURING PLANTS

Referring to humidity as applied to manufacturing plants, this was discussed in a very interesting manner by George V. S. Michaelis in a paper entitled "Sanitary Conditions in Ventilating and Humidifying Cotton Mills." (The National Association of Cotton Mfrs., Sept. 22-23, 1909.)

Mr. Michaelis says after pointing out the economic waste due to insufficient heating, resulting in chilled fingers of mill operatives:

"Pure air is, however, fully as important in influencing product as warm fingers. *Adequate ventilation,* therefore, is as vital a factor in summer as in winter.

"Curiously enough, humidification has developed in the minds of most mill men as a purely mechanical proposition; that is to say, in its relation to improved fiber conditioning. Adequate humidity has been recognized as increasing output through strengthening the yarn, reducing electrical tension, improving the yarn by causing the fibers to engage together more closely, and by giving greater elasticity at the same time that greater strength is given. This may be called the direct effect of humidification.

"Proper attention has *not* been given by mill men to the indirect effect of humidity which is upon the *working capacity* of the operative.

"Unbiased British officials and certain American engineers have demonstrated that, considered both immediately and ultimately, the direct or mechanical value of humidity works on parallel lines with the indirect or operative-working-capacity effect, and that the best results in dividends are secured by considering direct and indirect (mechanical and personal) effects together, in other words taking the resultant of the two working factors.

In certain buildings, where the results of changing from poor to good ventilation have been carefully observed, a marked improvement in the general health of the occupants has been manifest. For example, the records of the United States Pension Bureau show that when the offices of the department were located in scattered and poorly ventilated buildings, *18,736* days were lost by employees through illness in one year and about the same number for several successive years.

When the department became established in its new well-ventilated quarters the loss was reduced to 10,114 days' absence on account of illness, the working force being larger and the work increased.

The gain effected is not to be measured alone by the days' absence saved, but by the greater vitality and efficiency of the entire working force.

It is stated that improved ventilation resulted in the reduction in the death rate in the Dublin Lying-in Hospital from 50% to 5% for equal terms of years.

In the Boston City Hospital good ventilation is said to have given reductions in death rate from 44% to 13% in surgical wards and from 23% to 6% in other wards.

In regard to dwellings, investigations among the dwelling-houses of

Dundee, Scotland, showed that with an increase in air space per occupant there was a great falling off in the death rate. With air space per person in the ratio of 4 to 1, for example, the death rate was in the ratio of about 12 to 21, showing a reduction of over 40% in the case of the larger spaces.

Even though there be no method of ventilation provided, the mere abundance of space per occupant secures a certain air change owing to the fact that no partitions, floors or ceilings are perfectly tight, hence the greater the space per occupant the greater the surface of surrounding walls, etc., and the greater the accidental air leakage of spontaneous ventilation as some put it.

Prof. Winslow, of the Mass Institute of Technology, in a paper on "The Cash Value of Factory Ventilation," mentions that:

"Efficient production requires skilled and practical workers, in good physical condition, applying themselves, with energy and enthusiasm to their tasks.

"Irregularity of attendance, and the physical sluggishness and nervous inattention which accompany lowered vitality, mean direct *money* loss to the employer of labor, as well as a burden on the community at large."

As an example showing the results of improved ventilation the paper calls attention to the operating room of the New England Telephone and Telegraph Co. at Cambridge, Mass.—a long room having a capacity of 30,000 cu. ft., extending from front to back of a business block. Fifty or sixty women are employed in this room as operators.

"During the warmer months no difficulty has ever been experienced in ventilating the room by means of large windows at each end and by the use of electric fans. In the winter time, however, it was impossible to secure adequate natural ventilation without undue exposure to drafts. In the spring of 1907 a simple but efficient system of artificial ventilation was installed. . . .

"A marked improvement in the comfort and general condition of the operators followed this change and the betterment was sufficiently marked to show itself in a notably greater regularity of work."

Statistics collected and tabulated show that prior to the installation of the ventilating system *for the three winter months*, January, February and March inclusive, 4.9% of the force were absent in 1906 and 4.5% in 1907. With the ventilating system in use the absences for the same months in 1903 fell to only 1.9%; a striking reduction.

Perhaps nothing has focussed the attention of the general public on the *necessity* of fresh air so much as the crusade now being waged against tuberculosis. Dr. Woods Hutchinson, in his book, "Preventable Diseases," brings out in a most vivid manner the wonderful changes wrought in the prevention and treatment of this disease.

He advises us to learn to sit or sleep in a gentle current of air all the time we are indoors.

If ventilation could be had for little or no cost above that for heating alone, there would not be the "hue and cry" against it on the part of those whose "pocket nerve" is touched.

The fact, however, that in cold climates adequate ventilation costs money should not be allowed to stand in the way of its more general compulsory adoption.

Those who are most in need of it are, as a rule, least able to demand it, hence the necessity of the strong protecting the weak through the enactment of legislation to secure to children in schools, to adults in public buildings and to workers in factories and shops an adequate volume of pure fresh air. It is not pleasant to consider that in crowded, unventilated rooms the air must be breathed and rebreathed, nor is it pleasant to consider the other causes of atmospheric vitiation within enclosures as pointed out.

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Back numbers, - - - - - 15 cents a copy

A MOVEMENT that will be watched with much interest is the plan of the Federal Furnace League to standardize the ratings of warm air furnaces. Not only has the scheme been fully and carefully outlined, but the league has progressed to the point where it has secured a building in which to make the tests and has obtained the services of a heating engineer for that purpose. Members of the league are now being asked to send furnaces to the testing plant and it is proposed to establish a standard of furnace construction that will place this type of heating apparatus on a thoroughly scientific basis.

Noteworthy as the movement is, it is even more remarkable for its rapid and skillful development. It is scarcely a year since the plan was first formally broached and already the officers of the league refer to it as practically an accomplished fact. In this respect the efforts of the league are in marked contrast to the efforts of other bodies to standardize the ratings of heating boilers. To be sure, the subject is a broader one, but in the opinion of many it is doubtful if any plan will be successful that does not include a provision for the testing of such apparatus by the engineers themselves rather than by the manufacturers, and this the heating engineers so far have shown a reluctance to undertake. Certainly every effort to appropriate funds for the purpose has met with successful opposition, partially, but not wholly, for lack of sufficient funds.

We commend the enterprise of the Philadelphia organization. It has taken an advanced stand in establishing a method which, despite its well-known objections, is, in the opinion of many, the most logical way of obtaining the desired results.

ON ANOTHER page we publish a scheme developed by a Los Angeles architect for the cooling of such buildings as packing houses, but which, it is claimed, may be adapted for other buildings, including, possibly churches, schools and even residences. Whatever may be the limitations of the method as outlined, it is important as showing an instance of the attention that is being given to the solution of this problem. One frequently hears the prediction that in the years to come we will as soon think of living in overheated homes in the summer time as we would now think of spending the winter in unheated houses. If the problem is ever solved on a plane that will be commercially practicable, it is obvious that the work will come distinctly within the province of the heating and ventilating engineer and, for this reason, a peculiar interest attaches to any attempt to devise an economical and effective cooling system for general use.

Calculations for the Expansion of Pipes

By Ralph C. Taggart, C. E.

An exhaustive discussion of the calculations required for determining the expansion of pipes is contained in a paper contributed to the Transactions of the American Society of Civil Engineers for February, 1910, by Ralph C. Taggart. Mr. Taggart, who is associated with William J. Baldwin, the well-known heating and ventilating expert, has used the calculations extensively, especially in the design of underground runs of piping for steam and hot water heating, and his paper includes a series of charts presenting, in plotted form, the results of his calculations for various sizes of pipes. A typical chart for a 4-in. pipe is presented herewith and may be used as a basis for figuring the expansion with other pipe sizes. Mr. Taggart's paper, in substance, is as follows:

In the arrangement of steam piping (or other piping, the temperature of which is subject to considerable change), proper allowance must be made for expansion. Where the change in temperature, and hence the amount of expansion, is small, the stress may come well within the elastic limit of the metal. In such cases, of course, special arrangements to care for the expansion may not be required.

The calculation to determine the allowable stress in pipe may be readily made. In the case of ordinary iron pipe, we have the following:

The modulus of elasticity of wrought iron, or the stress divided by the strain, equals 29,000,000.

The coefficient of expansion of wrought iron, or the increase in length per degree F. per unit length, is 0.00000673.

The stress per degree F., therefore, would be 29,000,000 times 0.00000673, which is equal to 195.2 lbs. per sq. in. per degree F. difference in temperature. For a change in temperature of 100° F., the stress would become 19.520 lbs. per sq. in., which is more than the safe working stress in the iron, especially when it is considered that the stress would be largely increased at the various screw joints, where the thickness of the pipe is reduced by the depth of the thread.

For ordinary steam apparatus the change in temperature is at least 150° F. so that it becomes impossible for the elasticity of the metal to care for the expansion, even if the piping is very securely tied down. For, when the elastic limit of the metal is reached, a permanent set will result, and if this change in the form of the piping is repeated, a rupture may be expected.

Some years ago, the writer made calculations of the lengths of spring pieces for a large underground installation, and, from these calculations, he made a number of diagrams, which he has used to a considerable extent since that time. More recently, however, the original calculations have been somewhat extended, and it is believed that they will be of value to designing engineers and others.

A CASE WHERE THE EXPANSION IS IN ONE LENGTH ONLY

Fig. 1 represents two lengths of pipe, l_1 and l_2, connected by a 90° elbow. The lengths, l_1 and l_2, are supposed to represent the distances from the elbow to the points at which the pipe is held in line, or at which the pipe, if horizontal or vertical before expansion, must remain horizontal or vertical after expansion. It will be assumed that the principal expansion acts in a direction at right angles to l_1, and that the secondary or smaller relative expansion, if any, acts

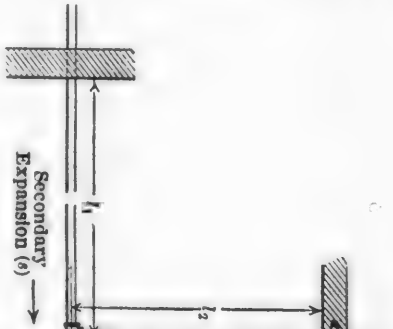


FIG. 1—TWO LENGTHS OF PIPE CONNECTED BY 90° ELBOW

at right angles to l_2. Consider first, a condition in which the secondary expansion is zero. The expansion is then at right angles, to l_1, and while the spring in the length of pipe, l_1, must care largely for the expansion, the length, l_2, is also a determinating factor. If l_2 becomes zero, or if the pipe at both ends of the length, l_1, is held horizontally, it is easy to determine the length of l_1 required for any given expansion, when the size of the pipe is known.

Under these conditions the formula may be worked out, and will be found to be as follows:

$$l_1^2 = \frac{87\,000\,000\ D\ r}{f} \qquad \ldots\ldots\ldots (1)$$

where the modulus of elasticity is taken as that of wrought iron or steel, *viz.*, 29 000 000.

Where l_1 = the length of pipe under strain, in inches;
r = the expansion, in inches, at right angles to the length of pipe, l_1;
D = the outside diameter of pipe, in inches; and,
f = the maximum fiber stress, in pounds per square inch.

This does not allow for the weakening of the pipe at the fitting.

In the case under consideration, the maximum strain occurs at both ends of the length l_1, of the pipe, and therefore the lessening in strength at the elbow or fittings should be considered, and allowance made therefor. For example, if the pipe is weaker than the fitting at this point, and if the pipe-threads cut into or reduce the effective section of the pipe to two-thirds of its normal section, the strain calculated should be reduced to two-thirds. The same result is accomplished by calculating for the usual strain, with an increase in expansion to one and one-half, for the reason that the maximum fiber stress varies directly as the expansion.

In this connection it is useful to note the following relations which hold true in the equation, $l_1^2 = \frac{87\,000\,000\,D\,r}{f}$, and also, in general, in other similar equations.

For a fixed length and size of pipe, the maximum fiber stress varies directly as the amount of expansion.

For a fixed length of expansion of pipe, the maximum fiber stress varies directly as the diameter of the pipe.

For a fixed length and maximum fiber stress, the expansion varies inversely as the outside pipe diameter.

For a fixed pipe diameter and expansion, the maximum fiber stress varies inversely as the square of the length.

For a fixed pipe diameter and maximum fiber stress, the expansion varies directly as the square of the length.

COMPLEX PROBLEM WHEN BOTH LENGTHS ARE CONSIDERED

If the length l_2, is to be considered, as well as the length, l_1, the solution of the problem becomes much more complex, but it can be worked out in a manner similar to the solution of the problem of a continuous girder. The solution of this problem results in the following equation from which certain curves have been worked out, which can be used when it is not desired to solve the equation for each independent case:

$$r\,(1+k) + s\,\frac{k^2}{1-k} = \frac{-2\,f\,l_1^2}{3\,D\,E}$$

Where r = principal expansion, in inches;
s = secondary expansion, in inches;
$k = \frac{l_1}{l_1+l_2}$ $\left(\text{or } \frac{l_1}{L}\right)$:
L = $l_1 + l_2$ (all in inches);
f = maximum fiber stress (pounds per square inch):
D = outside diameter of pipe, in inches; and,
E = modulus of elasticity.

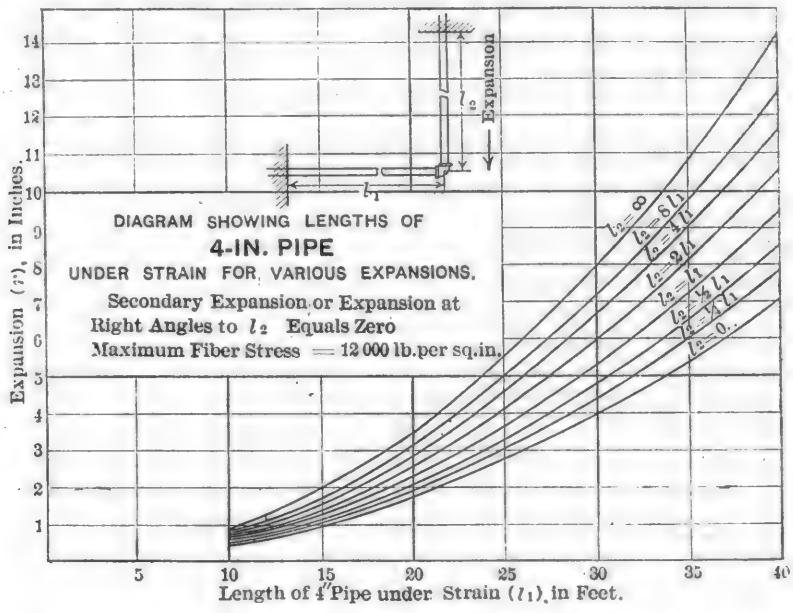


FIG. 2—DIAGRAM SHOWING LENGTHS OF PIPE UNDER STRAIN FOR VARIOUS EXPANSIONS

EXPLANATION OF CURVE.

The curve, Fig. 2, is calculated (for

wrought-iron or steel pipe), for a fixed expansion in a direction at right angles to l_1, which will be called the principal expansion, and, for a zero expansion, in the direction of l_1 or at right angles to l_2, which will be called the secondary expansion. If the secondary expansion must be considered, it may be calculated from equations which have been derived, or one may make use of the curves, Figs. 3 and 4, which are to be used in connection with the curve, Fig. 2, as will be explained later. It will be noted that the lengths of pipe, l_1 and l_2, are given in feet in all the diagrams, although, in the equations, the units are in inches.

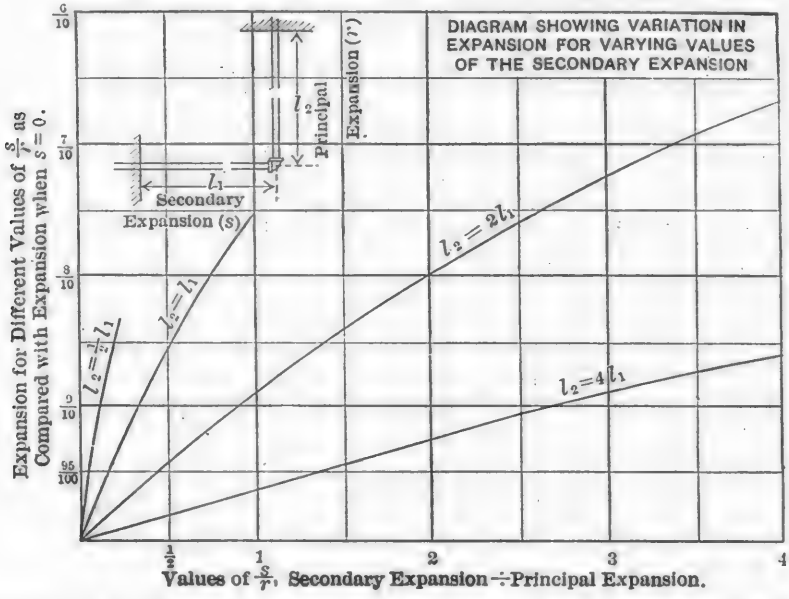


FIG. 3—DIAGRAM SHOWING VARIATION IN EXPANSION FOR VARYING VALUES OF THE SECONDARY EXPANSION

WEAKENING OF PIPE AT FITTING

There is one factor which has already been mentioned, to which, however, further attention should be given, that is the question as to how much allowance should be made for the weakening of a pipe at a fitting due either to the strength of the fitting or the threads on the pipe. The comparative values of the pipe strain at the joint and the fixed point of the pipe are shown graphically in Fig. 5.

In using this diagram in the following discussion, the loss in strength at the elbow is calculated as one-third. Therefore, an allowance should be made for the weakening at the fitting when the maximum strain is less than $\frac{1}{1}$, or $\frac{1}{1 - \frac{1}{3}}$.

$1\frac{1}{2}$ times the strain at the elbow. An examination of the curves on Fig. 5 will show that this is practically always the case when $l_2 = l_1$, or anything less than l_1. It is also the case when $l_2 = 2\,l_1$, and the secondary is equal to or larger than the principal expansion. It will be remembered that the principal expansion is always larger than $\left(\frac{l_2}{l_1}\right)^2$ times the secondary expansion, where l_1 is the length of pipe under strain at right angles to the direction of the principal expansion, and l_2 is the length of pipe under strain at right angles to the secondary expansion, but the principal expansion is not necessarily larger in quantity than the secondary expansion.

The allowance will depend on the ratio of the maximum strain to the strain at the elbow, which values are shown by the curves in Fig. 5. When $l_2 = 0$, the strain at the elbow equals the strain at the point where the pipe is held in line, and the strain at all intermediate points is also the same. The allowance for the weakening at the elbow, or for any joint between the elbow and the point where the pipe is held in line, therefore, should be in ratio of 1 to $1\frac{1}{2}$ or the strain allowable should be two-thirds of what otherwise might be calculated when $l_2 = 0$.

EXAMPLE SHOWING ADAPTABILITY OF DIAGRAMS

The diagrams may be used for a variety of combinations, and their adaptability is well illustrated by Fig. 6.

An arrangement of piping is assumed, in which a tee connects an 8- and a 6-in. pipe on the run and a 4-in. pipe branches from the tee at right angles to both. The length of the 8-in. pipe from the tee to the point at which it is held in line will be assumed to be 30 ft., and that of the 6-in. pipe will be assumed to be 25 ft. If the movement of the tee in the direction of the 6- and 8-in. pipes is 2 in., what should the length of the 4-in. pipe be from the tee to the point at which it is held in line?

It will first be assumed that the expansion of the tee in the direction of the 4-in. pipe is a negligible quantity. From the formula it is seen that the bending for a fixed maximum fiber stress varies inversely as the diameter of the pipe and the square of the length of pipe. The

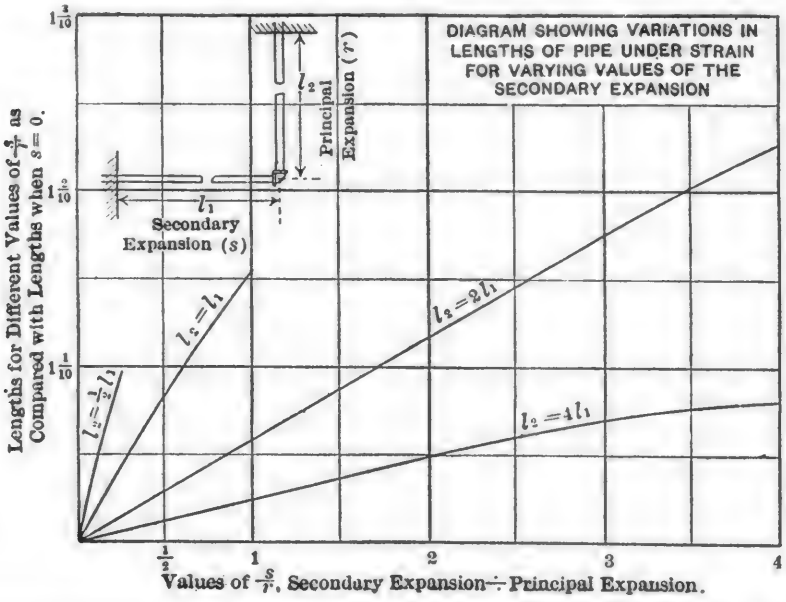


FIG. 4—DIAGRAM SHOWING VARIATIONS IN LENGTHS OF PIPE UNDER STRAIN FOR VARYING VALUES OF THE SECONDARY EXPANSION

30 ft. of 8-in. pipe, therefore, could, for a fixed maximum fiber stress, be bent only one-half as much as 30 ft. of 4-in. pipe. Therefore, the 30 ft. of 8-in. pipe is equivalent in its power to bend to 21.2 ft. of 4-in. pipe, since the lengths vary as the square root of the bending power, and $\frac{21.2}{30} = \sqrt{\frac{1}{2}}$. In the same way, the 25 ft. of 6-in. pipe is equivalent to $\frac{25}{\sqrt{1.5}} = \frac{25}{1.224} = 20$ ft. (about).

We have now the double stiffness of an equivalent of 21.2 ft. of 4-in. pipe and 20 ft. of 4-in. pipe. The stiffness is proportional to $\frac{1}{l_2}$, or to the reciprocal of the length squared. Therefore, the combined stiffness of the two 6- and 8-in. pipes would be equivalent to $\frac{1}{(21.2)^2} + \frac{1}{20^2} = \frac{849.44}{179\,776}$, which would be equivalent to a 4-in. pipe, with a length of

$$\sqrt{\frac{179\,776}{849.44}} = \sqrt{211.64} = 14.54 \text{ ft.}$$

If we use 14.54 as l_2, therefore, in Fig. 2, we can secure the necessary length of 4-in. pipe.

We see from this diagram that, if $l_2 = 0$, 2 in. of expansion for a 4-in. pipe would require a length of 21¼ ft. of 4-in. pipe. If $l_2 = l_1$, l_1 would be 18⅛ ft., but l_2 is equivalent to 14.5 ft. The next smaller value for l_2 is l_2 equals $\frac{1}{2} l_1$. In this case, l_1 would equal 19⅜ ft. In the first case, if $l_2 = l_1$, l_2 would be 18⅛. In the second case, if $l_2 = \frac{1}{2} l_1$, l_2 would be 9$\frac{1}{16}$ ft., but l_2 is actually 14½ ft., or about half-way between the two; therefore, l_1 lies between 19⅜ and 18⅛, and would not be far from 19 ft.

If now there should be a secondary expansion of ½ in., it would be necessary to increase the value of l_1. If l_2 could not be increased proportionately, the value of $\frac{l_2}{l_1}$ would be decreased, and in-

stead of being $\frac{14\frac{1}{2}}{19}$, or approximately $\frac{3}{4}$, it would become something less. From Fig. 4 it will be seen that when the secondary expansion divided by the principal expansion, or $\frac{s}{r} = \frac{1}{4}$, and when $l_2 = \frac{1}{2} l_1$, that the new length should be about 1.1 of the old length. This, however, would change l_1 so little that the value of $\frac{l_2}{l_1}$, while less than $\frac{3}{4}$, would not be nearly so small as $\frac{1}{2}$. We can, therefore, approximate the value of $\frac{l_2}{l_1}$ as $\frac{9}{10} \times \frac{3}{4} = \frac{27}{40} = 0.675$, or about $\frac{2}{3}$, and we can approximate the required length of l_1 from Fig. 4, as about 1.09 of the old length of 19 ft. or the new length of l_1 would become about $19 \times 1.09 = 20.71$, or about 20¾ ft.

or in its original direction. The length of the 8- and 6-in. pipes will be the same as before, and the length of the 4-in. pipe will be the same as in the last case, viz., 20¾ ft.

In this case the 8- and 6-in. pipes together have an equivalent length of 14.54 ft. of 4-in. pipe.

It is apparent that, in this case, the bending will be the same as for a 4-in. pipe of length $(20.7 + 14.54) = 35.24$ ft. with its end free. A free end is a similar condition to $l_2 = \infty$, as the fact of the ends not being free is due to a strain from l_2, and this becomes zero when $l_2 = \infty$. We will find, therefore, the expansion on Fig. 2 and note that it is nearly 11 in.

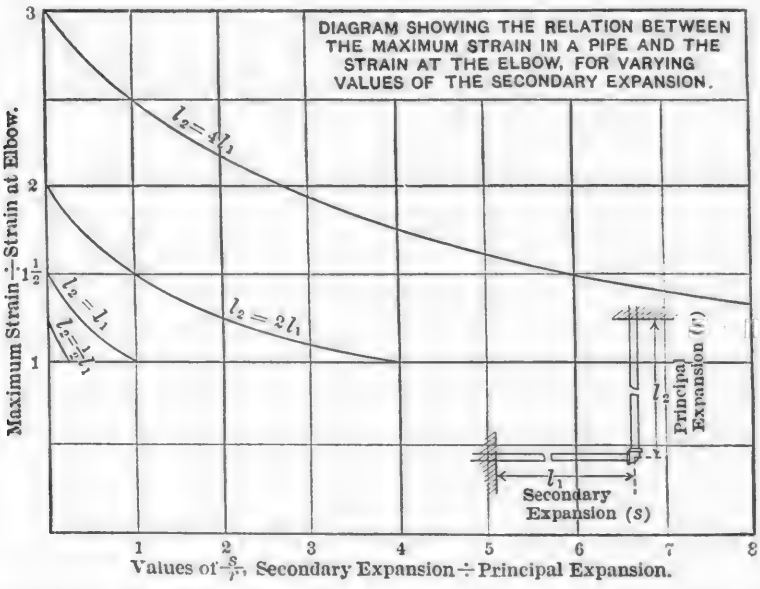


DIAGRAM SHOWING THE RELATION BETWEEN THE MAXIMUM STRAIN IN A PIPE AND THE STRAIN AT THE ELBOW, FOR VARYING VALUES OF THE SECONDARY EXPANSION.
Maximum Strain ÷ Strain at Elbow.
$l_2 = \infty l_1$
$l_2 = 2l_1$
$l_2 = l_1$
$l_2 = \frac{1}{2} l_1$
Principal Expansion (r)
Secondary Expansion (s)
Values of $\frac{s}{r}$, Secondary Expansion ÷ Principal Expansion.

FIG. 5—DIAGRAM SHOWING RELATION BETWEEN THE MAXIMUM STRAIN IN A PIPE AND THE STRAIN AT THE ELBOW, FOR VARYING VALUES OF THE SECONDARY EXPANSION

ANOTHER CASE

Let us now consider a case in which the strain is not caused by an expansion or movement at the tee, and in which the end of the 4-in. pipe farthest from the tee is not held in line. The problem will be to find what bending is possible at the end of the 4-in. pipe farthest from the tee, if this end is not held horizontal

WHERE BENDS ARE USED

It is sometimes the practice to use bends. An analysis of the conditions of strain in a 90° bend will show that such a bend has approximately the same strength as a pipe making a 90° turn with an elbow, the two sides of which are equal to the radius of the bend. The strength of the elbow itself should, of course, be considered independently, as elsewhere explained.

There are advantages, however, in the use of the bend—a lessening in the resistance to the flow of the fluid in the pipe, a lessening in the number of fittings used, and, in many cases, a lessening in the cost of the material and erection. In some specifications, copper bends are called for, and if the pipe is under a practically constant temperature, these may be fairly satisfactory, even if the stress in the metal is quite large. If the stress is kept fairly well

under the elastic limit, steel pipe is, however, as good as copper pipe, and if the elastic limit is nearly reached or exceeded, there is always danger of the breaking of the pipe.

If the pipe is arranged as shown in Fig. 7, and if the expansion is the same

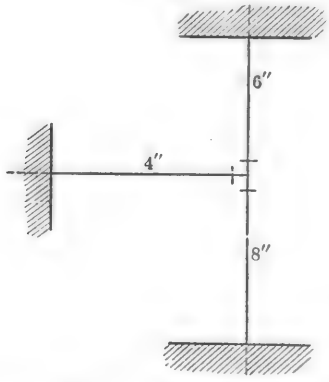


FIG. 6—SKETCH OF PIPING USED TO SHOW ADAPTABILITY OF DIAGRAMS

on both sides of the loop, the center of the loop will act as a fixed point, and l_1 will be the length of one side of the loop. If now the expansion were altogether on one side of the loop, the entire length of both sides may be taken for l_1, which would appear to make it advantageous to place the loop near an anchorage instead of half-way between two anchorages. The reason for this is that by placing the loop near one anchorage, we double the expansion acting on one side of the loop, but we also double l_1, and the expansion permissible varies as l^2, and not as l_1. If, however, the loop is placed half way between the two anchorages, the greatest movement of the pipe at any point is reduced by one-half,

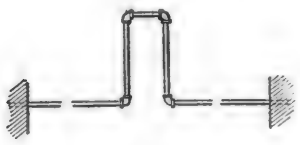


FIG. 7

and, at times, this may be of considerable importance.

In conclusion, a word may be said in regard to the use of the diagrams. They are calculated for a maximum fiber stress of 12,000 lbs. per sq. in. This gives an ample factor of safety for wrought-iron or steel pipe, and more, perhaps, than some will wish to allow. It is very easy, however, to use the diagrams with a higher stress, if so desired, since the stress varies directly as the amount of expansion. If it is desired, for instance, to use a maximum fiber stress of 16,000 lbs. per sq. in., it is only necessary to increase the amounts of expansion in the diagrams in the ratio of 16,000 to 12,000, or $\frac{4}{3}$. An expansion of 3 in. in the diagrams can then be made 4 in., and other values can be increased proportionately.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

HEATING

Electric Heating and Pyrometry. Abstract of the Tyndall lecture delivered by Prof. J. A. Fleming at the Royal Institution. Discusses methods of electric heating. Ills. 3500 w. Engng—June 10, 1910. 40c.

SHOP HEATING

The Heating, Ventilating and Air-Conditioning of Factories. Percival Robert Mosses. Two articles reviewing the present practice as to temperature, humidity and purity. Ills. 5000 w. each. Engineering Magazine—August, 1910. and September, 1910. 80c.

REFRIGERATION

The Cycle of Refrigeration. J. R. Wharton. A study of the cycle in the pressure-volume diagram, also in the temperature-entropy diagram, 7800 w. Ice & Refrig—July, 1910. 40c.

SHOP VENTILATION

Ventilation and Dust Removal in Cotton Mills. Discusses methods of improving the hygienic conditions in card rooms and gassing rooms Ills. 1500 w. Prac Engr—June 24, 1910. Serial. 1st part. 40c.

A Request for Catalogues

We are in receipt of a letter from Schwarzhaupt, Spiecker & Co., Hohenstauffenstrasse 25, Hamburg-on-Main, Germany, advising us that although they have so far installed small furnace heating systems for villas and country houses, it is now planning to undertake also the installation and furnishing of larger heating plants for factories, including fan systems. The company is desirous of securing catalogues and price lists on this subject and would appreciate it if American manufacturers of such apparatus would send them some of their trade literature.

Points in the Operation of Air Washers

The following discussion of questions arising in the use of air washing devices came up at the recent semi-annual meeting of the heating engineers' society, in connection with a topic on "The air washer as a means of humidifying the air for ventilation":

MR. THOMAS MORRIN: How may we determine the amount of humidity that an air washer will give off with the water at normal temperature, or to what temperature is it necessary to heat the water to obtain a given amount of humidity?

MR. ZELLWEGER: From observations I have made, when the temperature of the water is below that of the wet bulb, an air washer becomes less and less able to saturate the air. The further the water temperature gets away from that of the air, the less it can saturate, but as the water gets warmer, approaching the temperature of the air, it will become able to saturate the air according to the efficiency of the air washer itself. The washer can then saturate the air within 2% or 3%.

MR. MORRIN: If you wanted an air temperature of 70° and there were few people present, perhaps it would be desirable to have the saturation go to 75%. Now, how much vapor should be added to every cubic foot or thousand cubic feet of air to obtain that percentage of saturation? Will the air washer be efficient to 75% or 100% of the air supplied?

MR. ZELLWEGER: The air washer will bring up the humidity if the air is above the temperature of the wet bulb. But when the temperature of the water is below the temperature of the wet bulb, it will not, and the efficiency will continue to decrease as the water gets colder. If the water is recirculated, as is done, until its temperature comes up to the wet bulb temperature, then it will saturate the air.

MR. MORRIN: In a rough experiment, I have ignored the temperature of the air washer water and injected, by a manual adjustment, a jet of steam into the air. But that was objectionable for the reason that the steam was slightly odorous from some chemical combination with the water. With the steam jet, however, I could get the amount of saturation required.

MR. ZELLWEGER: That is along the line I mentioned, of heating the water.

MR. MORRIN: Of course I had no means of measuring the quantity of steam I was turning in and had no means of determining the temperature of the water below the saturation point.

PROF. KINEALY: This is one of those subjects upon which the manufacturers of air washers have quantities of data. For a given temperature of air and a given degree of saturation, when the air enters the washer, the water will adjust itself in temperature to the temperature and degree of saturation of the air. That is to say, if you put into the air washer tank water at, say, 80°, and the humidity outside is comparatively low, the water and the air will be cooled and the water will be cooled faster than the air until, finally, the water will reach a certain temperature, say 74°, and the air a temperature of, say 78°. The water will remain at that temperature, 74°, and the air will remain at 78° as it passes from the water. If you should put water in the washer at, say, a temperature of 50°, the temperature of the air will remain at that same temperature of 74°, and the temperature of the water will be raised.

The amount of water that will be evaporated into the air depends upon the humidity of the air entering the washer, upon the velocity of the air passing through the jets of spray water, upon the degree of fineness of the separation of that water, and, also, upon the number of gallons of water per thousand or hundred cubic feet of air passing. If the humidity is too high it is simply necessary to turn off some of the water and you will then get a lower humidity of the air leaving the washer.

I think I am safe in saying the most of the manufacturers of air washers adjust the air and the amount of water so that the relative humidity of the air leaving the washer is between 80% and 90%. It is difficult to get 90% at all times, but you can almost always count on 85% relative humidity of the air leaving the washer.

MR. THEODORE WEINSHANK: What I aim to do in such cases is to endeavor to maintain a constant differential between the incoming air and the spray water. If a constant humidity is to be maintained in the room, a certain differential between the incoming air and the spray of water must be maintained. This differential can be obtained in two ways: either by increasing the temperature of the incoming air by sending it through a tempering coil, or by increasing the temperature of the spray water by admitting steam into the spray tank.

If a humidistat is placed into the air duct, same can be arranged so that it will either turn on steam into the tempering coils, or turn on steam into the spray tank and, by such means, maintain a constant differential between the air and the spray water.

I always aim to install a tempering coil consisting of three two-row sections, making a total depth of six rows of pipe and, by means of automatic control, aim to maintain a constant temperature of the incoming air and increase or decrease the temperature of the spray water.

MR. MORRIN: In regard to changing the volume of water more or less to control the humidity involves the mechanical necessity of a waste or loss of power above and below a normal condition. That does not appeal to the average owner who has to pay high for his power, and the raising and lowering of the temperature of the water is very easy to accomplish providing you are recirculating your water. But where you are drawing constantly from a supply with no varying temperature you will find conditions are at a fixed point and to vary from that point will involve a combination of arrangements that would necessarily be of the least cost to the owner. There are many cases on the Pacific slope where it is cheaper to buy water than it is to operate a pump. In such a case, where the water comes from a constant source, the varying temperature of the water would be highly impracticable.

MR. WEINSHANK: If it is cheaper to buy water than it is to circulate same; or in other words, if the water is being wasted into the sewer, then the humidistat placed in the air duct can be so arranged that it would increase or decrease the temperature of the incoming air.

MR. MORRIN: We do not use tempering coils. We have no frost or freezing weather there and we do not make use of a tempering coil.

MR. WEINSHANK: If a tempering coil is not used, which means that the usual temperature in the locality where the air washer is being used does not fall below freezing; in that case the humidistat will control the steam jet into the spray tank. This is on the proviso that the water is being recirculated. However, if neither a tempering coil is being used nor is the water being recirculated, no humidity control can be obtained.

MR. MORRIN: This would materially raise the cost of operation.

PROF. KINEALY: What we do is to get everything under uniform conditions. We try to wash the air at a certain fixed temperature and we know that if we can wash the air at that temperature and we put water into the tank, whether that water is warm or cold, when it is put into the tank it will soon come to a certain fixed temperature. Now if that water is drawn off and new water put in, in a very short time the new water will come to this fixed temperature. It does not take over five or ten minutes for the water to do this. In one test, we put ice in the water and cooled the water down to about 50° but it soon came back again to about 68° or 70°.

MR. WEINSHANK: I believe I have answered Mr. Morrin's question, but I will further state that if the spray water is not recirculated and no tempering coil is used, it is impossible to obtain humidity control; but if humidity control is more essential than air washing, I would recommend that Mr. Morrin use a pump and recirculate his water and have the temperature of that water controlled such that would enable him to maintain a constant differential between the air and the water.

MR. MORRIN: But I was speaking of eliminating the pump. Now the quantity of water that passes through the air washer is fixed. If you are going to eliminate a certain per cent. of solids from the air, you must use a certain quantity of water and the temperature of the water controls the humidity, as I understand it.

PROF. KINEALY: I did not know that you were taking your water from the source of supply under sufficient pressure to spray it. We try to get the water under a certain head and to keep that head as nearly uniform as possible in all plants. When we obtain what we call standard conditions, we know what results we can secure. But if we should change the temperature or pressure of the water repeatedly, we could not control our results.

Wrong Method in Hot Water Piping

I have seen a number of hot water heating plants where the application, in my judgment, is wrong and expensive. The return lines, for instance, instead of being carried on the basement ceiling, providing there is no basement radiation, is sometimes carried down below the floor and thence back to the boiler. My experience and judgment is that this is a wrong application of hot water heating design and is bound to work against the system. If the return main is placed on the ceiling you will have the benefit of it, whereas if you place it below the boiler, you will have to force the water back to the boiler, and there is not only the increased expense of running the piping there, but the unsatisfactory operation of the apparatus. In two buildings that I know of, the return mains were taken out of the trenches and hung from the ceiling with satisfactory improvements in the operation of the system.

In my earlier work, I had a job where there were some basement returns and I conceived the idea of connecting the returns from the upper stories to the basement radiation, but I found it interfered with the whole system. While the basement radiation had to have the returns under the floor, the returns from the upper stories were placed on the basement ceiling and the system worked well.—W. M. MACKAY *before the Heating Engineers' Society.*

National District Heating Association

The committee on revision of the constitution of the National District Heating Association is preparing several drafts and will meet for conference and preparation of final drafts in Pittsburg at the meeting of the executive committee which will be held in that city sometime early in December. The executive committee, which consists of the president and secretary, three vice-presidents, A. C. Rogers, of Toledo, O., and E. J. Keifer, of Easton, Pa., will meet early in December for the purpose of fixing the time and place and deciding upon the programme of the third annual convention of the association. The exact date of the meeting of the committee has not yet been fixed.

Since the second annual convention, held in June, the following applications for membership have been received and approved:

Merchants' Light, Heat and Power Co., San Francisco, Cal.

Tuscarawas County Electric Light, Heat and Power Co., New Philadelphia, O.

Harrisburg Steam Heat and Power Co., Harrisburg, Pa.

Evans, Almirall & Co., Chicago, Ill.

Otto E. Osthoff, Chicago, Ill.

York Steam Heating Co., York, Pa.

Ernst Schielevy, Hamburg, Germany.

McGraw Publishing Co., New York, N. Y.

The printed proceedings of the second annual convention, bound in cloth form, are now ready for distribution and are sent to all old members and all new members that apply for membership. Owing to the limited edition they are not for sale and are sent only to those who carry a membership or apply for the same. Distribution began September 1.

American Society of Engineer Draftsmen

On June 18 the first steps were taken to form a permanent organization to be known as the American Society of Engineer Draftsmen, embracing every branch of the profession, including mechanical, electrical, civil, architectural, marine, sanitary, automobile and aeronautical draftsmen. The first meeting of the Society was held July 27. The formation of this organization, which was conceived by E. Farrington Chandler, a well-known designer and inventor, marks the first effort to form a national society among draftsmen.

Draftsmen have long felt the need of an organization, both from an engineering and a fraternal standpoint, which would be the means to establish a higher professional standing and place them on a recognized professional plane, in the field of engineering.

A feature of the society is the opportunity offered juniors, affording means by which they may become familiar with the demands of practice, in the drafting room, while students or employees in other branches of industrial work, as is also an employment bureau coöperating with employers.

The qualifications for membership are such that a standard will be established as in other branches of engineering, and it is the aim of the society to maintain this standard, and to secure recognition from every concern employing draftsmen.

The officers chosen are: President, E. Farrington Chandler; vice-president, Wm. B. Harsel; secretary and treasurer, Henry L. Sloan, with headquarters at 116 Nassau St., New York.

American Peat Society

The American Peat Society met in Ottawa, Canada, August 25-27, last. On the opening day of the meeting a description of the government peat plant at Alfred, Ont., was described by A. Anrep, Jr., of the Department of Mines, after which a special train took the members and guests to Alfred for an inspection of the plant. About 1,600 tons of peat have been taken from the bog this season, all of which will be sold for fuel. Other papers presented at the meeting were: "The Exploitation of Our Peat Bogs for the Production of Fuel for Domestic and Industrial Purposes," by Dr. Eugene Haanel, president of the society; "The Work of the Peat Engineering Company," by Francis J. Bulask, Toledo, O.; "Peat Power Generation," by Dr. T. Arthur Mighill, Boston, Mass.; "History of the Peat Industry of Canada," by Alexander Dodson; "A new Portable Peat Machine," by Ernest V. Moore, Peterborough, Can.; "Peat Briquetting," by Dr. J. McWilliam, London, Ont.; and "The Mark Process of Drying Peat," by C. E. Mark, Chicago.

The following officers were elected: President, Dr. Eugene Haanel, Department of Mines, Ottawa; vice-presidents for eastern states, John N. Hoff, New York; Great Lakes and Mississippi Valley (eastern division), Carl Kleinstuck, Kalamazoo, Mich.; (western division) L. B. Lincoln, Chicago; southern states, Robert Ranson, St. Augustine, Fla.; Pacific states, C. V. Imeson, Los Angeles, Cal.; Canada, Dr. J. McWilliam, London, Ont.; New York section, Dr. Charles F. McKenna, New York; New England section, O. E. Moulton, Dover, N. H.; Minnesota section, Max Tolz, St. Paul, Minn.; secretary-treasurer, Julius Bordollo, Kingsbridge, N. Y.

The 1911 meeting of the society will be held in Kalamazoo, Mich.

National Association of Sheet Metal Contractors

The National Association of Master Sheet Metal Workers was rechristened the National Association of Sheet Metal Contractors at its sixth annual convention, held in Philadelphia, August 10-12, 1910. The reason for the change in name was given in the president's address. After quoting from the by-laws, under Article 1, Section 1, to the effect that "any individual, firm or corporation engaged as employers in any of the sheet metal trades necessary in the erection of buildings may be eligible for membership in this association," the president said:

"A careful study of this particular section will show that those eligible for membership extend beyond the sheet metal contractor. Any firms engaged as employers in any of the sheet metal trades necessary in the erection of buildings can very well include those firms, for instance, in the manufacture and erection of metal ceilings. It was never the intention of our association to include such firms as members." He therefore recommended a revision of the section stated so that only sheet metal contractors should be eligible for membership and he also recommended that the matter be referred to a committee or to the trustees. This was done and, on a separate motion, the change in the organization's name was effected.

The report of the Furnace Heating Committee stated that its members had met with the officers of the Federal Furnace League and, among other things, had recommended the establishment of a standard basis for rating warm air furnaces, so that the principle of the plan proposed by the Federal Furnace League in this matter, published on another page of this issue, has the endorsement of the Sheet Metal Contractors' Association.

A noteworthy feature of the convention was the display in Lu Lu Temple of manufacturers' exhibits. The booths were numerous and contained elaborate and artistically-arranged exhibits of practically all classes of goods used by the sheet metal worker.

The following officers were elected for the ensuing year: President, Robert J. Braley, Providence, R. I.; first vice-president, Frank J. Smith, Norfolk, Va.; second vice-president, John Bogenberger, Milwaukee, Wis.; third vice-president, John Hussie, Omaha, Neb.; fourth vice-president, Frank J. Hoersting, Dayton, O.; secretary, Edwin L. Seabrook, Philadelphia, Pa.; treasurer, W. A. Fingles, Baltimore, Md.; trustees (for one year) Otto Goebel, Syracuse, N. Y.; (two years) Frederic Hummell, Buffalo, N. Y.; (three years) P. H. Lenderking, Baltimore; J. A. Dougherty, Nashville, Tenn., and K. I. Willis, Moline, Ill.

NEW DEVICES

The New "Conoidal" Fan

The Buffalo Forge Company, Buffalo, N Y, has recently placed a new centrifugal fan, called the "Conoidal," on the market for which they make many interesting claims.

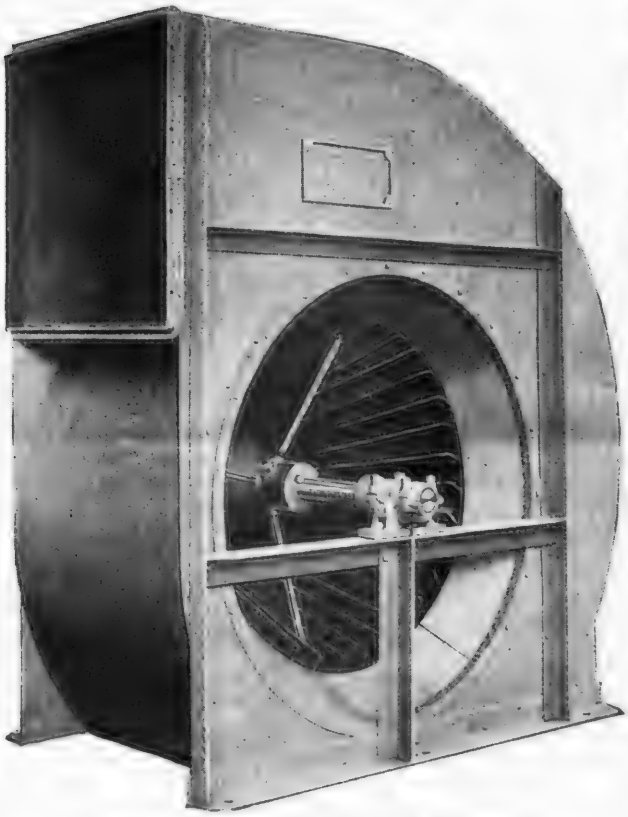
The blast wheel being a frustrum of a cone and having the blades cut from the surface of a cone, suggests the name Conoidal.

The Conoidal housings are involute in shape, are built of heavy steel plate throughout and are braced with angle irons, both horizontally and vertically. The scroll allows a discharge of increasing area to be built in housing, thus eliminating the heavy discharge connection. The extra long self-aligning bearings have an oil chain which insures constant and copious lubrication. Oil chains have been found to be preferable to rings where fans are operated at low speeds.

The tendency of the air passing through a fan is to follow the most direct line from inlet to outlet. This not only causes an uneven pressure across the outlet of the fan, but produces eddy currents, and decreases the efficiency. In the Conoidal fan this is overcome by decreasing the depth of the blades from the back to the front. Not only does this produce an even pressure over the entire outlet and eliminate all counter currents, but makes an exceptionally rigid wheel. The increased depth of the blades near the pulley side of the wheels scoops up the air near the center of the fan, increasing the capacity from 10% to 20%.

The diameter of the blast wheel is greatest at the outlet side on account of blades of greater depth producing higher pressures than shallow ones with the same peripheral velocity.

Single and double Conoidal fans to handle from 1,500 cu. ft. air per minute upwards are being built The single inlet fan reduces the head room from 5% to 10% and double fan 33⅓%, besides producing a remarkable saving in power. The manufacturers claim for this new type of fan that it is superior in efficiency by actual test to any multi-blade fan on the market, and that it is stronger and therefore more suitable for high pressure work. They make the statement that this type of fan shows to best advantage when a large capacity is required and the space limited, or when speed conditions are such that a small diameter wheel of the Conoidal type suits the engine or motor speeds best, but that in



THE NEW CONOIDAL FAN AND HOUSING

many cases, where these conditions do not exist, steel plate centrifugal fans of the standard type will give equal results in every particular.

A general characteristic of the multivane type wheel is that only 75% of the total head is static or pressure head, while the standard centrifugal wheel produces a total pressure of which about 90% is the static head. Consequently, for work which requires a considerable static head the multivane fans are not particularly well suited. For mine ventilation or forced draft for boilers a standard fan would actually show up to better advantage.

Care must be taken in every installation lest the use of the multivane fan be a disadvantage, as the relatively large proportion of dynamic pressure must be converted into static head without loss in the discharge piping at the fan outlet. This piping should be proportioned to the fan outlet, with an increaser for reducing the air velocity gradually and without harsh lines or angles

The Buffalo Forge Company's engineering department devotes all its time to these and similar questions, and the Buffalo Conoidal fan is the final solution of one of the most important problems.

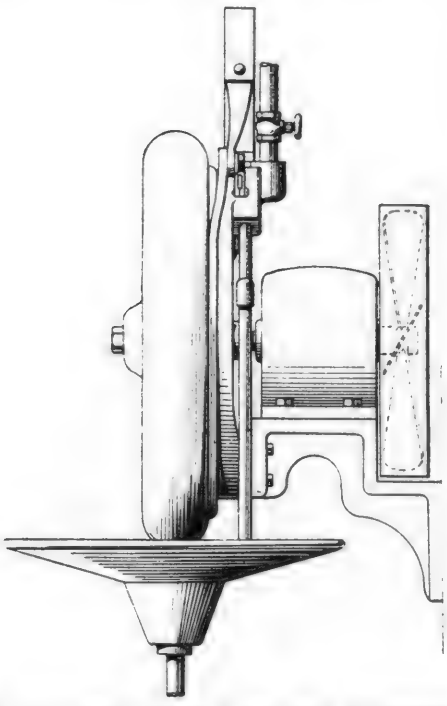
Consultation with the manufacturers may throw light on many questions about fan applications.

The Hygrosso Humidifiers

Another humidifying device, designed especially for use in textile mills, is known as the Hygrosso humidifier. It is described as the only humidifier with automatic control, where each head is a complete unit which can be adjusted to control the humidity in its own 20,000 or 25,000 cu. ft. of air space. Thus these humidifiers can be set so that the humidity will be uniform throughout the room or different parts of the room may be independently controlled. Other features of the apparatus are its ability to vaporize 5% of the water employed, its operation without the use of water or steam pressure, obviating the use of a pump. No air pressure tank is used with this device or float valves, nor are there strainers or atomizer nozzles. The power used is stated to be ¼ H. P. per head.

The illustrations show the motor-driven Hygrosso humidifier with automatic regulator attached on the upper part of the frame. The small well shown contains an inclined nozzle which communicates with the water supply pipe. The lower part of this well is provided with an elongated tubular opening adapted to receive the water from the nozzle when not otherwise prevented. The water received in the tubular opening flows downward into the pipe which delivers the water to the hu-

HYGROSSO HUMIDIFIER, DRIVEN BY DIRECT CONNECTED ELECTRIC MOTOR



SIDE VIEW OF MOTOR DRIVEN HYGROSSO HUMIDIFIER WITH AUTOMATIC CONTROL

midifier. The tubular opening in the bottom of the well is of less width than the well so as to form a space which receives the steam of water from the nozzle if the valve be opened too much. This prevents any possibility of supplying too much water to the humidifiers and causing what is generally termed "wetting down." Any water passing from the nozzle which does not find its way into the tubular opening is received in the well and carried off by the overflow pipe. A reciprocating bar is provided on its end with a water diverting head and adapted to be moved to contact with the stream of water issuing from the nozzle in small well whenever it is desired to divert the water from falling into the tubular opening.

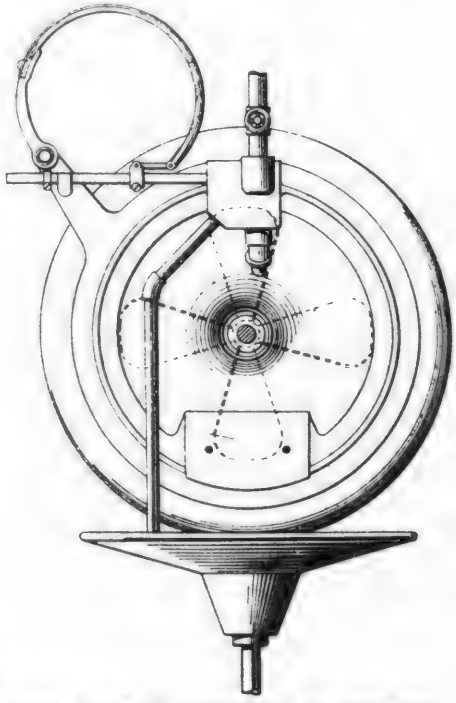
This action reduces or cuts off entirely the water supply to the humidifier and the instrument is set so this will take place when the relative humidity is at the desired point. This diverting head and bar is restricted in its movement by an adjustable stop. This adjustment is made so the head may move in front of the stream of water just sufficient to divert it.

The reciprocating bar is moved by means of the expansion and contraction of the curved proportion which is connected to the bar by means of a lever. This curved portion is of compound construction having an outer band of brass and an inner curved part of wood. Wood parts are sawed with the grain running substantially at right angles to the outer edge of the strip which makes the device more sensitive. The expansion and contraction of the curved portion is affected entirely by changes in the hygrometric conditions of the atmosphere so the instrument may be set to have the reciprocating bar divert water supplied to the humidifier at any percentage of relative humidity desired. Once set it requires no further attention and has been found to be remarkably accurate and sensitive, regulating the water supply to the humidifier in response to the slightest hygrometric changes. The Hygrosso humidifier is manufactured by John W. Fries, 88-90 Centre Street, New York.

The Turbo-Humidifier

This device, as described by the inventor, Albert W. Thompson, mechanical superintendent of the Amoskeag Mills, at Manchester, N. H., is designed "to impart additional humidity to the air in factory or other buildings."

"The water," continues the inventor, "is not under pressure; the amount used may be regulated at one point for the system in a room—or group of rooms, or by means of suitable valves controlling the individual nozzles; and in the latter case, the initial adjustment of the nozzle members would not be disturbed. While



REAR VIEW OF HYGROSSO HUMIDIFIER, WITH AUTOMATIC CONTROL, SHOWING MOTOR REMOVED

I can regulate the quantity and fineness of the spray to meet widely varying requirements, simplicity of construction and easy accessibility for adjustment or cleaning have been retained, together with a low cost of production."

The Turbo-humidifier combines the old injector idea with the principle of centrifugal force. Its name was suggested by the steam turbine. The principle upon which it operates, however, should not be confused with either the injector or atomizer principle.

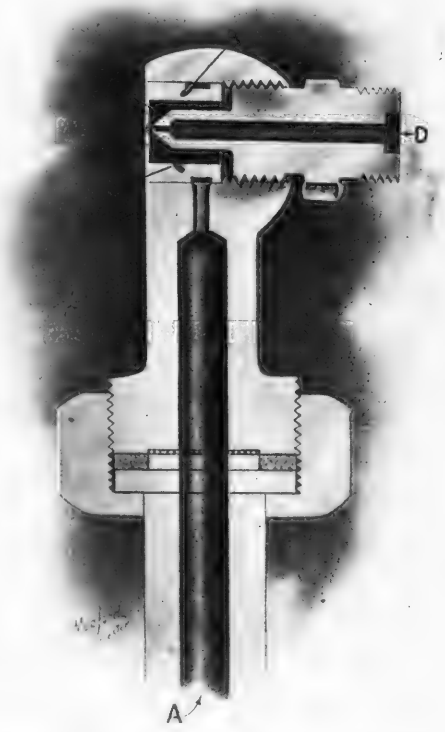
Air is supplied at about 65 lbs. pressure at the orifice A. (See Fig. 2.) It will be seen that this air passes through the tangential orifices in the bushing, B-B'; produces a vacuum at the end of the water nozzle E, and by so doing, draws water through the tube D.

The centrifugal motion imparted to the air by the Turbo principle actually pulverizes the water in the chamber C before it is delivered to the atmosphere. The importance of this centrifugal action is noted when the vapor is delivered to the atmosphere, since it spreads the vapor and distributes it before condensation can occur.

Since it is well known that vapor follows the law of gases, and diffuses itself throughout an enclosure, no fans or artificial means are really necessary for its distribution.

A description of a complete Turbo system is something like this:

Air is supplied through a main pipe to the several branch lines in which the heads are located. Parallel with these branch air lines are water lines. These are run dead level.



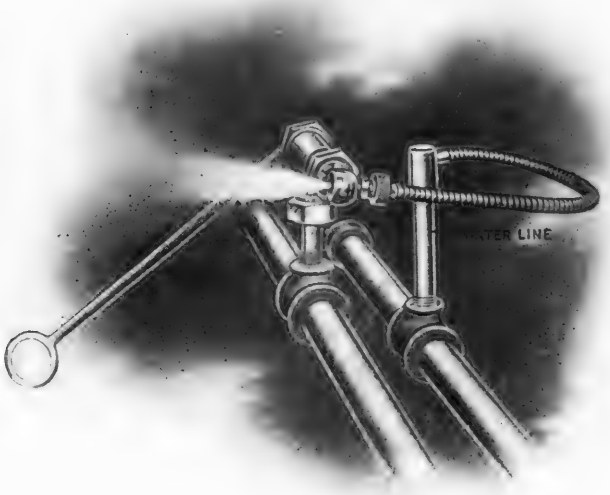
SECTIONAL VIEW OF SPRAY HEAD, TURBO HUMIDIFIER

Water is supplied through a covered, float-controlled tank. This tank is equipped with over-flow pipe, draw-off pipe, filter, etc., and is covered to keep out dust and lint.

The supply tank is a special one, but is about the size of that furnished with any complete toilet room set.

One of these tanks will supply from sixty to seventy heads, but in large rooms, the best practice is to divide the system into two, three or four separate sections. The tanks may be located in toilet rooms, or other convenient, accessible places. The water line, controlled by the overflow pipe, is located 1½ in. below the centre line of the head.

It is impossible for water to overflow from



THE TURBO HUMIDIFIER

the heads on floors, machinery, stock, etc., as when the air is shut off there is no power to lift the water up to and into the head; when the water is shut off the air has no water to lift—hence no damage either way.

The water inlet to the head is connected to the riser nipple in the water branch pipe by means of a non-corrosive, flexible, metallic tube, which being provided with union connections, makes all parts accessible and adjustments easy. Two unions, one vertical and the other horizontal, make it possible to direct the jet in any desired direction.

A fine mesh brass gauze strainer for the air connection is located in the union. Any foreign substance that can pass through this strainer can also pass through the air ports. The Turbo valve or cock is located under each head, so that any may be shut down without interfering with the others. Shutting off the air shuts down the head.

An independently driven air compressor is recommended with this apparatus.

In capacity, based on cubic contents which one head will supply, each Turbo-humidifier serves from 6,000 to 20,000 cu. ft. of space, according to the processes and local conditions.

The Turbo-humidifier is manufactured by the G. M. Parks Co., Fitchburg, Mass.

Trade Literature

Zellweger Air Washing and Cooling Fan is the subject of a new catalogue containing much interesting information on the subject of air washing, published by J. Zellweger & Sons, St. Louis, Mo. After describing in detail the construction of the Zellweger apparatus and its method of operation, the catalogue has something to say about the usual guarantee regarding the "removal of 98% of all impurities." "The relative cooling effect," states the writer, "effected by an air washer is a more positive indication of its efficiency than the removal of 98% of all impurities, which latter performance cannot be established by any reliable and practical instrument.

"The customary requirement that an air washer cool the air to within 4° of the temperature of the circulating water calls for a humidification of about 82%, which is easily attained under ordinary conditions.

"Air from outdoors in moderate and warm seasons has usually a humidity of 40% to 70% and when such air is purified in a Zellweger air washer it acquires a humidity of about 90% and is cooled to within about 2° of the temperature of the circulating water, which itself always tends to acquire the temperature of the wet bulb of a hygrometer. This wet bulb temperature on warm summer days is between 70° and 80° and indicates the temperature at which air leaves a Zellweger air washer in warm weather."

Directions are included for the use of the Zellweger apparatus in connection with indirect heating. Tables are given of the dimensions and capacities of these fans, while other tables and charts contain useful hygrometric data. The illustrations include a photographic reproduction of a 9-ft. Zellweger filter wheel while other views show detailed plans of the Zellweger Standard Type A and Special Type H apparatus.

Valve World for July, 1910, published by the Crane Co., Chicago, is devoted entirely to the celebration of the 55th anniversary of the company's birth. The festivities began July 3 and continued for several days. Among the notable events was a reception at Jerseyhurst, the country home of Mr. R. T. Crane, to the managers of the branch houses of Crane Company and their wives. A picnic at Riverview Park was held July 5 and was the principal feature of the celebration. On the 6th the officers of the company, the branch house managers, heads of departments, superintendents and foremen were the guests of Mr. R. T. Crane, Jr., at a banquet held at the Auditorium Hotel, Chicago. The events of the week are fully illustrated in the *Valve World*, and include views of the reception at Jerseyhurst, the events at Riverview Park, together with some of the handsome gifts, including an elaborate silver service presented to Mr. Crane in honor of the occasion. On the cover is reproduced three generations of the Crane family, all of whom are actively associated in the management of the company.

J-M Packing Expert for August, published by the H. W. Johns-Manville Co., New York, contains among other things an interesting description, fully illustrated, of a typical installation of the J-M metallic packing which is made of a special foundered gray cast iron. In service this packing develops a hard polished surface which reduces the friction of a rod to the minimum. The new packing is made from rings built up in segments with ground joints.

Practical Heating for August, 1910, published by the J. H. McLain Co., Canton, O., has, as its leading article, an illustration of pressed steel radiation, which is being marketed by this company. The president's message, written by George E. Downe, is an effective argument for the place of the jobber in modern business. There is also the usual fund of interesting personal items regarding the doings of men in the trade.

TRADE AND MISCELLANEOUS NOTES

Deaths

David Ranken, Jr., founder of the David Ranken Mechanical Trades School in St. Louis, died at the age of 74 years. He was born in Ireland but had lived in St. Louis since 1862. He endowed the school in June last by a gift of $3,000,000.

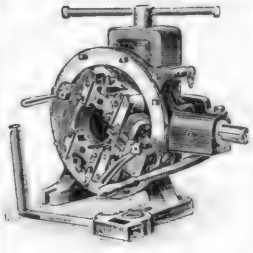
Henry Mueller, vice president of the H. Mueller Mfg. Co., manufacturers of heating and plumbing goods, Decatur, Ill., died suddenly of apoplexy, August 13, at his home in Decatur. He was 52 years old. Mr. Mueller was the oldest of the brothers who are associated in the H. Mueller Mfg. Co., and had been connected with the firm from an early age. He was an expert in the mechanical side of the business and with Philip Mueller was in direct charge of the company's factory. He leaves a widow and one daughter, also his mother and five brothers.

H. O. Canfield, president of the H. O. Canfield Co., Bridgeport, Conn, manufacturers of rubber goods, especially for plumbers' use, died at his home in Bridgeport, at the age of 63 years He was one of the pioneers in that line of business, and had been actively engaged in it since 1885. Upon the incorporation of the H. O. Canfield Co., in 1904, he was chosen president. He is survived by a widow and two sons, both of the latter being associated with the H. O. Canfield Co.

C. Graham Beach, member of the firm of Story & Beach, New York, general sales agents for heating and plumbing supplies, died suddenly at Cragsmoor Inn, Ellenville, N. Y., July 17, as the result of a hemorrhage. He was married June 9 last and is survived by his widow.

Miscellaneous Notes

Charles G. Armstrong, New York, has been appointed consulting engineer for the 25-story municipal building in course of erection near the entrance to the



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Brooklyn Bridge. The heating, ventilating and mechanical equipment of the building has been designed by Nygren, Tenney & Ohmes, New York.

American District Steam Co., Lockport, N. Y., is installing a central station heating plant at Streator, Ill. The work is in charge of A. W. Peters, representing the company.

Minneapolis, Minn.—A fresh air room in every school building with more than eight rooms is advocated by Dr. Charles H. Keene, supervisor of hygiene in the Minneapolis public schools. The idea is to shut off one of the school rooms from the heating plant of the building and have the windows kept open constantly. In this room Dr. Keene would place the most delicate children, wrapped in blankets with a special teacher to direct their studies.

Logansport, Ind.—Work of installing the new hot water and steam heating system has been commenced by the Central Station Engineering Co., of Chicago. It is expected that the plant will be completed by the opening of the heating season in the Fall.

Niagara Falls, N. Y.—It is announced that the William Harris Heating Co. is about to open a plant in this city. The company has secured the old factory of the Niagara Falls Heating Co., which it will remodel and enlarge.

Chicago, Ill.—350 street cars, equipped with the Cooke ventilating system, were put in operation August 3, as a result of the recently-enacted requirements of the Chicago health department. The cars are equipped with automatic ventilating devices which were described in THE HEATING AND VENTILATING MAGAZINE for April, 1910.

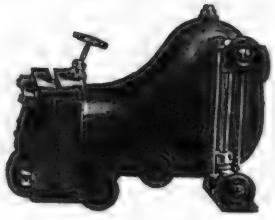
Sioux City, Ia.—The heating plant operated by the Security Bank Building Co., which furnished heat to several downtown office buildings, has been temporarily abandoned, owing to the fact that the company could not furnish light as well as heat. In the past the company has operated under a franchise to furnish heat only and on this account the president of the company, W. P. Manley, states that the maintenance of the plant is of doubtful expediency.

Hibbing, Mont.—As the result of the requests of a number of property owners, a municipal heating plant will be built at that place and connected to the city power plant, thus utilizing the exhaust steam from the power plant.

Kennett, Cal.—The merging is announced of the Sacramento River Power Co., the Central Heat, Light & Power

McDaniel Improved Steam Trap

WILL DO THE WORK

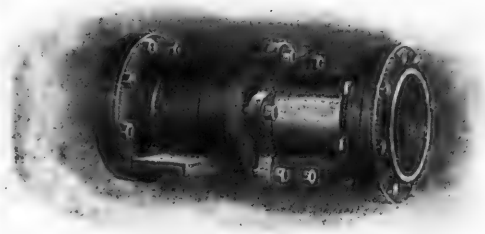


When you need a Steam Trap buy one you know will work. With a McDANIEL we take all the chances. Don't pay until you are satisfied. We have been 25 years manufacturing Steam Traps and know there is no better trap made. May we send you one for trial?

Watson & McDaniel Co.

160 North 7th Street - PHILADELPHIA, PA.

Send for Catalogue



High Grade Expansion Joints

We manufacture expansion joints for inside, outside and underground work. In all sizes from 1 to 30". Our experience covers a period of over thirty years. Let us figure on your requirements.

Write for Bulletin 104

American District Steam Co.

Lockport, N. Y. Chicago, Ill.

Co., of Oakland, and the Merchants' Light & Power Co., of San Francisco. A new site has been chosen two miles below Kennett, to which the waters of the Sacramento River will be diverted through a two-mile tunnel.

Atlantic City, N. J.—A tax of $2.00 on every steam, hot water or hot air heater hereafter placed in any building in Atlantic City is a provision of the new building code which has recently been adopted. Every such heater must be submitted to the building department for approval and the fee of $2.00 is for the inspection of same.

July building operations in 41 cities show a considerable decrease from those of the corresponding period a year ago. In the eastern cities the decrease was 50%; middle west, a decrease of 6%; southern cities, an increase of 36%; and in the Pacific Coast cities an increase of 18%. The figures in New York city are $5,801,975, as against $17,778,390 for July, 1909.

Northern Heating and Electric Co., St. Paul, Minn., has been mortaged for $800,000. The control of the St. Paul company was recently acquired by the H. M. Byllesby Co., of Chicago, and large improvements are contemplated. It is understood that there will be no change in the management and the name will remain the same. H. M. Byllesby Co. has already secured control of several small power plants in the vicinity of St. Paul and has ample water power rights not far away. One of the proposed changes is the connection of the St. Paul plant with the water power at Cannon Falls.

Thomas Tait has been appointed heating engineer for the Moline Vacuum Vapor Heating Co., Moline, Ill. He was until recently with the R. Haas Electric & Mfg. Co., Springfield, Ill.

Baldwin Engineering Co., New York, steam fitting contractors, New York, has failed and William B. Leonard has been appointed receiver of the assets, which are estimated at $64,287. The liabilities are placed at $88,371. A committee of creditors has been appointed to arrange a plan of settlement.

New York City Master Steam and Hot Water Fitters chartered a steamer Aug. 10 for a sail up Long Island Sound, with a shore dinner at Witzel's Grove. The outing was the result of the closer affiliation of the master fitters of New York due to the troubles in the trade in the earlier part of the year when the journeymen were on strike.

Manufacturing Notes

Stanley G. Flagg & Co., Philadelphia,

Positive Ventilation for Moderate Size Rooms

THERE need be no more unventilated rooms in homes and offices. The STURTEVANT Ready-to-Run Electric Ventilating Set meets all ventilating requirements for small and medium size rooms.

It consists of a small patented Multivane fan of wonderful efficiency, direct connected to an electric motor, and is arranged to be used independently or attached to a window board.

It positively ventilates by blowing in fresh air or carrying away foul air. It is light, portable, easy to install, and runs from electric light socket. Numerous Heating, Ventilating and Sanitary Engineers and Plumbers are installing these sets in residences, clubs, offices, factories, laboratories, telephone booths and all *moderate* size places requiring ventilation.

Special prices to Heating and Ventilating Engineers, Electrical Houses, Hardware Dealers, etc. Retail price: Size A, $35.00; B, $45.00; C, $55.00.

B. F. STURTEVANT CO., Hyde Park, Mass.

Pa., announce the removal of their main offices to the new Morris Building, 1421 Chestnut street.

Crane Co., Chicago, has purchased a lot 220 x 440 ft. at Market and Missouri streets, Indianapolis, on which the firm will build a 10-story branch office and warehouse. The company has also awarded the contracts for the erection of its new 5-story building at Tacoma, Wash.

Cameron-Schroth-Cameron Co., Chicago, Ill., suffered a $70,000 fire loss August 25, when its 6-story building at Michigan and Bush streets was partially burned. The company announces that there will be no interruption in its business.

Kansas City Pressed Metal Radiator Co., Kansas City, Mo., recently organized with a capital stock of $75,000, will shortly commence operation, negotiations now being under way with several cities for a suitable factory site. The following officers have been elected: President, James Muir; Vice-president and general manager, Thomas H. Walker; secretary, W. Z. Flanery; treasurer, Paul F. Covington.

Ilg Electric Ventilating Co., Chicago, manufacturers of ventilating apparatus, announces that owing to the heavy increase of its business, it has moved to larger quarters at 154-156 Whiting St., Chicago, where new and improved machinery has been installed.

United States Radiator Corporation, Dunkirk, N. Y., in addition to its other properties, has taken over the business of the Central Foundry & Radiator Co., of Paeolo, Kan. The company announces that branch offices are located and stocks are now carried in the principal cities of the country. Among the well-known patterns manufactured by the United States Radiator Corporation are the Furman, Triton, Capitol and Sunray boilers, and the Triton, Capitol and Sun and Paeolo radiators.

New Firms and Business Changes

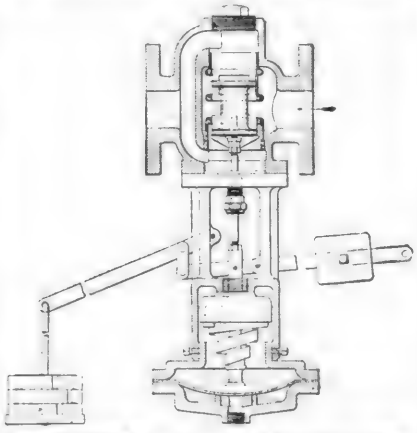
Jacob J. Vollrath Mfg. Co., Sheboygan, Wis., has increased its capital stock to $500,000.

Vulcan Electric Heating Co., Chicago, Ill., has increased its capital stock from $100,000 to $125,000.

Blake & Williams, New York, heating and ventilating engineers and contractors, have purchased property at 14-16 Cornelia St., New York, upon which they will build an 8-story fireproof building for their own use.

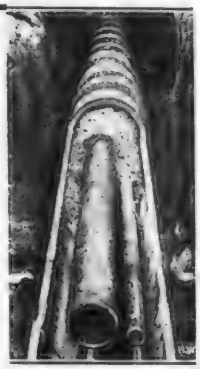
McRae & Roberts, Detroit, Mich., manufacturers of heating supplies, has increased its capital stock from $195,000

WATERS
Reducing Valves
for steam heating purposes a specialty.
Also valves for vacuum heating systems.



Manufactured by
Waters Governor Co.
34 Oliver St., Boston, Mass.

Why J-M Sectional Conduit is Replacing All Others



It costs less to install J-M SECTIONAL CONDUIT than other permanent conduits and costs nothing for maintenance. J-M Conduit carries steam 1,000 feet without practically any loss.

It is the only watertight conduit.

Is easily opened after installation and leaks in pipe readily located. Can be taken up and relaid without injury.

The weight or movement of pipes cannot damage it. Not affected by acids or gases.

Is equally efficient for conveying gas, water, brine or any other liquids underground.

If you have detached buildings to heat, or steam to carry long or short distances for power purposes, you will be interested in our catalog.

Write nearest Branch for Catalog 103

H. W. JOHNS-MANVILLE CO.

Baltimore	Dallas	Milwaukee	Pittsburg
Boston	Detroit	Minneapolis	San Francisco
Buffalo	Kansas City	New Orleans	Seattle
Chicago	London	New York	St. Louis
Cleveland	Los Angeles	Philadelphia	

[1092]

to $395,000. The company will shortly build a new factory, doubling its present floor space.

New Incorporations

American Hydro Vacuum Cleaner Co., San Francisco, Cal. Capital, $250,000.

Imperial Valve Co., Chicago, capital, $20,000, to manufacture and deal in steam appliances and mechanical devices. Incorporators: John Penrose, Albert Land and Ernst A. Ploeger.

Carey Co., Cleveland, O., capital, $150,000, incorporated as selling organization in connection with the Carey-Philip Mfg. Co., manufacturers of pipe covering materials.

Massie Steam Generator & Radiator Co., Chicago, incorporated to deal in heating and lighting appliances. Incorporators: John G. Massie, H. O. C. Massie and A. Cavana, 6542 St. Lawrence avenue, Chicago.

Louvre Ventilator Co., Boston, Mass., capital, $25,000, to manufacture ventilators. President, John T. Clark; treasurer, S. Walter Lindemann; secretary, H. R. Burgess.

Steam-Vapor Heating Co., Brooklyn, N. Y., capital, $10,000, to conduct a heating contracting business. Incorporators: Christian Baechtold, Emil A. Baechtold and Louis Christensen.

Pulser Heating Co., Montgomery, Ala., capital, $100,000, to manufacture heating and plumbing supplies and to conduct a heating and plumbing contracting business. President, A. G. Stople; first vice-president, R. Hugger; second vice-president, W. J. Tucker; third vice-president, F. E. Stople; treasurer, E. S. Hugger; secretary and general manager, Frederick Ausfeld, all of Nashville, Tenn. Others interested are T. J. Mooney, of Nashville, and W. J. Tucker, of Atlanta, Ga.

E. W. Peck Co., Derby, Conn., capital, $12,000, to conduct a heating and plumbing business. Incorporators: E. W. Peck, Edward A. Peck and Archibald Peck.

Elgin Damper & Heat Regulator Co., Elgin, Ill., capital, $25,000, to manufacture dampers and heat regulators. Incorporators: F. C. Gitpill, M. J. O'Neill, E. L. Ryan and Eugene Cliff.

Elmhurst Heating Co., Elmhurst, Ill., capital, $2,000. Incorporators: Frederick Marx, C. H. Harvard and J. K. Elliott.

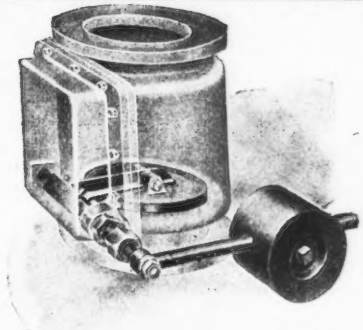
F. W. Miller Heating Co., Chicago, capital, $10,000, to engage in heating contracting business. Incorporators: Frank W. Miller, Clarence D. Bauers and C. Robbins.

Wechtel Plumbing Co., Toledo, O., capital, $50,000, to conduct a heating and plumbing business. Incorporators: H. J. Chittenden, R. M. Marks, Robert Newbegin, M. A. Matthews and G. Andrews.

Plural System Ventilator Co., Chicago, capital $50,000, to manufacture ventilators and heating specialties. Incorporators: Norman A. Beck, Frank P. Miles and Edward C. Martin.

Warlic Heater Mfg. Co., St. Louis, Mo., capital, $100,000, to manufacture heating apparatus. Incorporators: W. J. Warner, Daniel E. Lichty and Jasper Taylor.

Duke Heating and Water Co., Richmond, Va., capital, $12,000, to conduct a heating and plumbing contracting busi-



EXCELSIOR STRAIGHTWAY BACK PRESSURE VALVE

A glance at the illustration will show its extreme simplicity and freedom from complicated parts. It has an area through the seat equal to that of the pipe.

As a back pressure valve it can be used in a vertical or horizontal position. It is especially desirable for exhaust steam heating. Also well adapted for use as a relief or free exhaust valve for condensing engines.

JENKINS BROS., New York, Boston, Philadelphia, Chicago

DIXON'S PIPE-JOINT COMPOUND

MAKES TIGHT JOINTS

by lubricating the threads and thus allowing the joints to be fully tightened up.

WRITE FOR FREE SAMPLE

JOSEPH DIXON CRUCIBLE COMPANY, JERSEY CITY, N. J.

ness. President, T. W. Duke; secretary and treasurer, H. S. Rucker. J. P. Carson, Manchester, Va., is also associated with the firm.

Charles D. Ranney Co., Chicago, Ill., capital, $4,000, to conduct a heating contracting business. Incorporators: Chas. D. Ranney, Anna E. Ranney and A. E. Duncan.

Villinger Plumbing & Heating Co., Williamsport, Pa. Capital, $15,000.

Western Pipe & Steel Co., Los Angeles, Cal., capital, $500,000. Incorporators: A. C. Dunham, of Pasadena, and H. W. Lunceford, W. F. Howard, J. A. Talbot and W. G. Talbot, of Los Angeles.

Beckley Plumbing & Heating Co., Beckley, W. Va., capital, $10,000. Incorporators: J. S. Ellson, C. S. Proctor, E. P. Ewart and others.

Duluth Water Heating Co., Duluth, Minn., capital, $25,000. Incorporators: E. L. Cass, James Shipp and Miss Myrtle Stewart, all of Duluth.

Contracts Awarded

Lewis & Kitchen, Chicago, heating and ventilating buildings of the Wesleyan University at Bloomington, Ill.

Crosby & Co., Fort Wayne, Ind., heating Hope Hospital in that city for $4,000.

McDonald Bros., Lebanon, O., heating Opera House at that place for $4,000.

Crook, Kries & Co., Baltimore, Md., heating apparatus and power plant for new 15-story office building for the Fidelity and Deposit Co., Baltimore, Md. The work will cost $51,392; also heating and power plant for the Southern office building, Washington, and central heating plant for the Hannahmore Academy at Reistertown, Md.

Sawrie-Miller Co., Nashville, Tenn., heating new theatre in Knoxville.

F. S. Spencer Warming & Ventilating Co., Minneapolis, Minn., heating and ventilating high school building at Grand Fork, N. D.

Thomas Haverty Co., Los Angeles, Cal., heating and ventilating 11-story office building for the Los Angeles Trust and Savings Bank for $9,800.

Fitzpatrick & Hoepfner, Columbus, O., heating and ventilating old main building at the Ohio State University for $17,713.

W. F. Sheahan, Topeka, Kan., heating and ventilating Senate Chamber at the State capitol for $4,000.

W. H. Taylor, Latah, Wash., heating local high school building.

Libby & Blinn, Hartford, Conn., heating new operating building at the New Britain General Hospital.

M. C. Vandiver Co., Atlanta, Ga., heating and ventilating State street school, at that place, for $2,762; also Boulevard school for $2,600; and Fraser street school for $2,750.

Atlanta Steam Heating Co., Atlanta, Ga., heating and ventilating Bell street school for $3,497.

Moncrief-Dowman Furnace Co., Atlanta, Ga., heating and ventilating Formwalt street school for $3,496.75; also Calhoun street school for $3,856.

W. J. Maguire, Ltd., Toronto, Can., heating mains for the new central lighting and heating plant for Toronto University. L. K. Comstock & Co., New York, will build the power house and tunnels. The entire plant will cost $250,000.

W. J. Patterson Co., Appleton, Wis., heating county asylum at West Salem for $17,813.

Northern Plumbing & Heating Co., Eveleth, Minn., heating and plumbing new high school building at Gilbert, Minn.

M. J. O'Neill, Minneapolis, Minn., heating, ventilating, air washing, vacuum cleaning apparatus and gas fitting for the Dayton Dry Goods Co. store, at that place, for $25,000.

Thomas Heating Co., Racine, Wis., heating, ventilating and power plant for the new high school building at Niles, Mich. The plant will cost $17,041.

McCreery Air Washer

MADE IN

GALVANIZED IRON AND COPPER

ALSO MADE IN

RE-INFORCED CONCRETE

which is *practically indestructible* as it cannot *rust* or *corrode*. The entire inside surface of the spray chamber is water-proofed and given a sanitary finish. All the advantages of our cleaning surfaces are retained.

If you need a complete small ventilating and air purifying plant which will fit in restricted space and will cost little to operate, buy one of our *Self-Contained Equipments*.

Descriptive circulars, giving dimensions, mailed on request

McCreery Engineering Company

OFFICE: **Detroit, Mich.**

WORKS: **Toledo, O.**

W. H. Inman, Laramie, Col., heating and plumbing Elks' building for $3,990.

Charles A. Ludden, Chicopee, Mass., heating and ventilating the George S. Taylor school in Chicopee for $4,300.

Pierce & Cox, Boston, Mass., heating and ventilating Prescott school in Charlestown for $12,073.

J. P. Dwyer, Boston, heating addition to Wyman school for $4,487.

Pechman & Pechman, Chattanooga, Tenn., heating and plumbing Jefferson street school, at that place, for $3,572.19.

Ordway Heating Co., Newburyport, Mass., heating new school building at that place for $2,850.

J. M. Dougherty, Ottawa, Ill., power plant for the Illinois Traction Co., at Venice, near East St. Louis, for $20,000.

A. W. Murray, Hoopeston, Ill., heating and plumbing new township building at Gibson City, Ill., for $7,000.

Kelsey Heating Co., Syracuse, N. Y., heating and ventilating system for the Ashfield Seminary at Ashfield, Mass., for $3,500.

M. B. Sanders, Little Rock, Ark., hot water heating Government barracks at Fort Logan H. Roots for $6,158.

S. Faith & Co., Philadelphia, Pa., heating and ventilating Nebinger school for $8,500.

Smollen & Schoenleben, Racine, Wis., remodeling heating plant at the Racine County asylum for $4,500.

Thos. M. Carey, Defiance, O., hot water heating system for the Winterich green houses, at that place, for $4,000.

Downey & Kruse Co., Milwaukee, heating new asylum building at Reedsburg, Wis., for $6,367.

Taylor-Flagg Co., Meriden, Conn., steam heating three of the State tuberculosis homes for $5,000.

Stone-Underhill Co., Boston, Mass., heating and ventilating Lawrence high school at Falmouth, Mass.

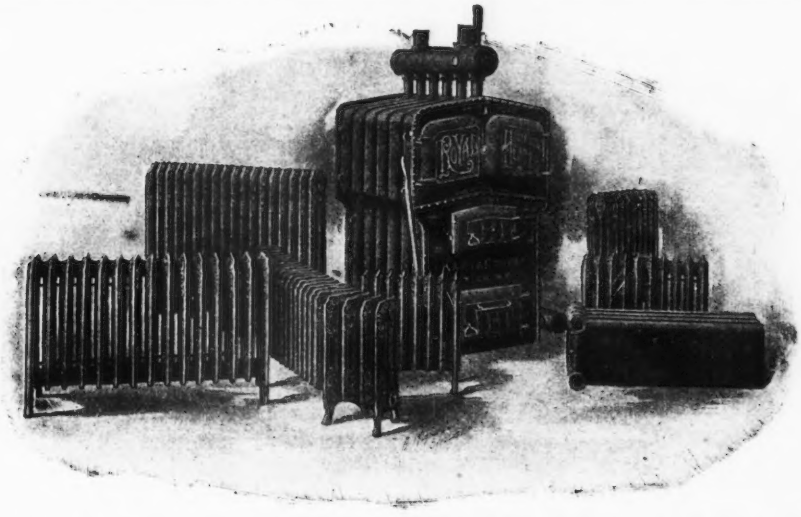
G. S. Blodgett Co., Burlington, Vt., heating and plumbing court house and post office building in Rutland, Vt.

Lewis & Kitchen, Kansas City, Mo., heating and plumbing new high school building at Joplin, Mo., for $14,050.

T. C. Basshor Co., Baltimore, Md., heating and power plant for the Catholic University of America at Washington, D. C.

C. H. Julian, San Diego, Cal., was the lowest bidder for the steam heating and laundry equipment for the San Diego County hospital, at $11,352.

Gearen & Ziegler, Sioux City, Ia., heating and plumbing Western Iowa building at that place for $4,500.



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